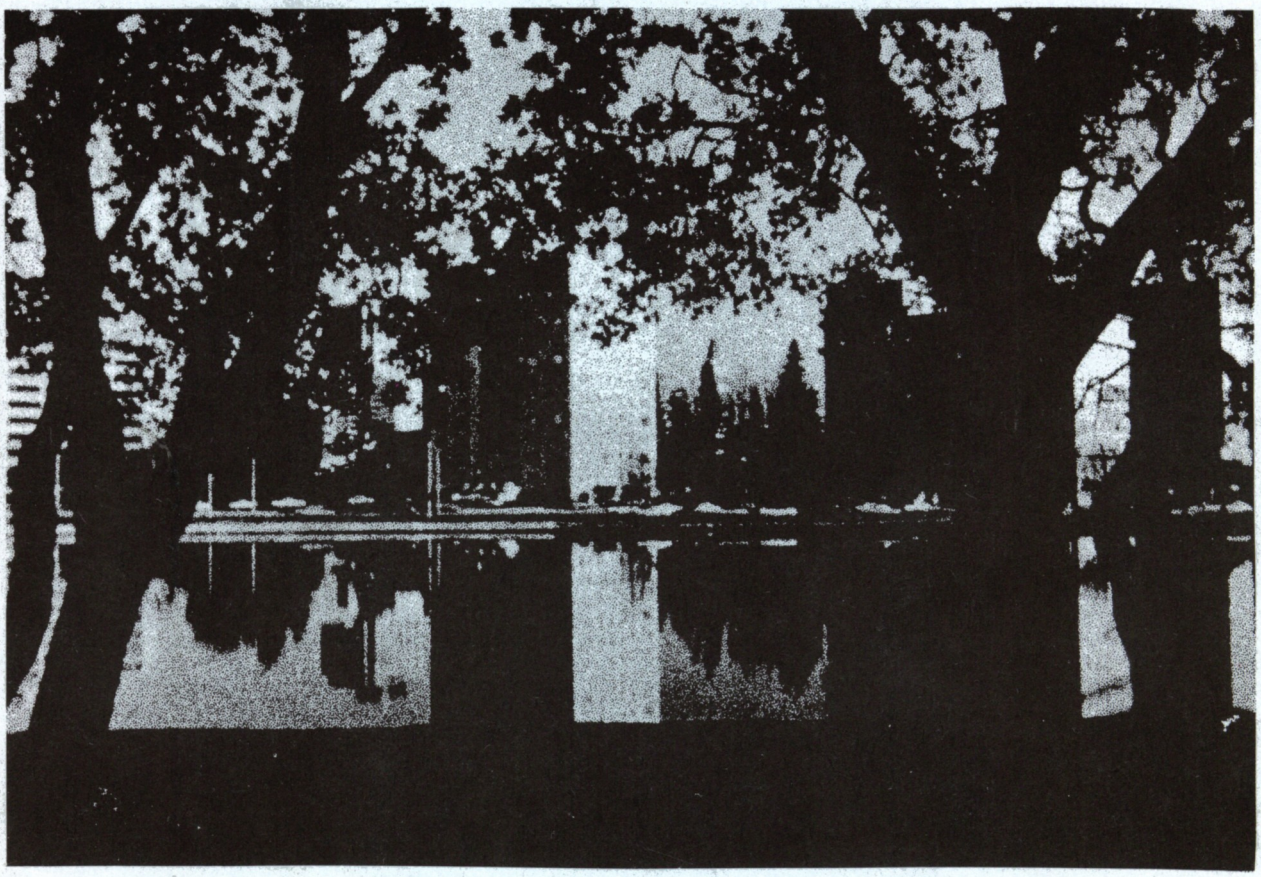
A RESEARCH AND DEVELOPMENT PROGRAM

FOR

URBAN FORESTRY



U. S. Department of Agriculture, Forest Service, Washington, D.C.

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December 9, 1977

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EXECUTIVE SUMMARY

What is the best use of natural forest and water resources that intertwine and separate the great metropolitan complexes of the Nation? What is the optimum mix of manmade communities and natural environments? What should go where? Are certain areas already so overloaded with commercial and transport activity as to constitute ecological disaster zones? Should some urban forest areas be retained in an undeveloped state? Have we considered the importance of visual order and excellence of design in creating ecologically and aesthetically stable conditions in communities that people can be proud of?

Just to raise these types of questions is to realize that society's use of forest and water resources throughout many of our urban areas is in chaos. We are in danger of creating a regional kaleidoscope of conditions that are so lacking in concern for the basic underlying needs of society for ecological support systems as to make urban land use planning and management an exercise in futility.

The idea that unlimited, uncontrolled growth is good, is no longer an unquestion dogma. Indeed, quite the contrary, communities across the land are alarmed by pollution, congestion, ugliness, sprawl, decaying neighborhoods. The problems are tied inexorably to the destruction of open space, forest conditions, and water resources that are required for community enhancement and basic necessities of life.

This document was prepared to assist agencies, institutions, and private organizations select and conduct research and development programs in urban forestry. The magnitude of the cost for the total effort is relatively high and the scope of the research challenge is extremely broad. This document provides a framework that any agency or institution can use to select research and development activities that best meet their overall program orientation and budget constraints.

Research and development programs are described to:

1. Assess human benefits of urban forests.

2. Understand the basic biological and physical processes in urban forests that produce benefits for society, and develop management guides to maximize the quality of urban environments.

3. Develop methods to breed, select, establish, maintain and protect urban forest resources.

4. Investigate strategies to integrate sound urban forestry planning and management with the total urban planning and development process.

FOREWORD

We must recognize that America's forest wealth is not confined to rural or wildland areas. Trees in the city are being increasingly recognized as a vital asset in soil and water conservation and in upgrading the quality of an urban environment. Open spaces, greenbelts, buffer strips, roadsides, community parks, wooded residential and industrial zones, expanding urban areas and new communities--these are new target areas of forestry concern. The potential benefits are many--energy conservation, pleasant and serene environments, increased natural beauty, cooling shade, recreational environments, better air to breathe, less street noise, protection from winds, and more birds and wildlife.

COMMENTS REGARDING THE VALUE OF THIS R&D DOCUMENT

"We found this to be a well written and organized planning document.... It was essentially complete."

Carl M. Berntsen
Director
Timber Management Research
USFS
Washington, D.C.

"I wish to commend the Committee for doing an excellent job in developing this document."

W. F. Custard
State Forester
Charlottesville, Va.

"I feel that the target areas are well chosen as are the (specific problem areas) and priorities. The presentation is logical and thorough."

John R. Tiller
State Forester
Columbia, S. C.

"The document is well-thought-out...the priorities are realistic."

D. L. McFatter
State Forester
Baton Rouge, La.

"(The document) indicates that our thinking towards what might be developed has been on a scale of a vastly lesser magnitude than what truly exists. The review document presents an in-depth analysis of the full potential and provides a broad insight to the whole concept of urban forestry."

Elmore C. Grim
Director
Bureau of Natural Resources
Frankfort, Kentucky

"We found the proposal to be very comprehensive and ambitious.... We realize that what we have reviewed is really the first effort to establish urban forestry program needs."

John Bethea
Director
Division of Forestry
Tallahassee, Florida

"The analysis attacks primary urban forestry considerations.... If the...Commission of Forestry can be of service to you, please do not hesitate to call on us."

Rhett S. Bickley
Urban Forester
South Carolina State
Commission of Forestry
Columbia, S. C.

"It is a thorough, very in-depth proposal...all four research targets could conceivably stimulate the interest of all or most of our faculty as represented in resource science, management, and policy."

William J. Stambaugh
Professor of Forest Pathology
Duke University
Durham, N. C.

"The overall document is well done and the findings are excellent."

Keith R. Shea
Director
Forest Insect and Disease Research
USFS
Washington, D.C.

"This document is very complete, and certainly considers the many important aspects of urban forestry research needs. We hope that this will lead to increased activities in the urban forestry research field."

Allen J. Schacht
Assistant Area Director
Cooperative Forestry
USFS
Upper Darby, Pa.

"We comprehend the thrust and the approach taken by the authors of this document."

Samuel S. Cobb
Director
Bureau of Forestry
Harrisburg, Pa.

"The results of this (document) will be of value to the newly hired urban forester."

Ernest J. Gebhart
Chief
Division of Forestry
Ohio Department of Natural Resources
Columbus, Ohio

"Your Committee has prepared a detailed and comprehensive plan which has few if any omissions from the standpoint of analyzing researchable social and biological problems in the urban forestry field."

William H. Davis McGregor
Dean, Forest and Recreation Resources
Clemson University
Clemson, S. C.

"This is a very ambitious program, one that should produce awareness and meaningful information on the importance of trees in our urban society."

Fred C. Galle
Director of Horticulture
Galloway Gardens
Pine Mountains, Ga.

"It is a comprehensive program that should be a major benefit to urban forestry."

William J. Lowe
Associate Geneticist
Texas Forest Service

"I think the analysis is badly needed, and for the most part, excellent."

Steve Sandfort
Urban Forester
Georgia Forestry Commission
Fayetteville, Ga.

"This proposal will be of great interest to professionals as well as researchers in the urban planning field.... Guidelines that are likely to emerge from this R&D effort will be of immense use both in land use planning and land use management in urban areas."

F. Stuart Chapin, Jr.
Professor of Planning
University of North Carolina
Chapel Hill, N. C.

"I believe it to be a fine statement and very comprehensively treated."

Eric L. Ellwood
Dean
North Carolina State University
Raleigh, N. C.

"The analysis is an excellent piece of work...and is innovative in its classification of projects. Most of the urban forestry questions that have been raised in professional meetings or in the literature appear in the analysis."

J. O. Lammi
Professor
North Carolina State University
Raleigh, N. C.

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INTRODUCTION

Purpose

The purpose of this report is to outline the problems, establish tentative priorities, and estimate the costs for a range of 10-year research and development (R&D) programs needed to improve benefits from urban forests.

Urban Forestry

An urban forest is that portion of the urban ecosystem that consists of forest vegetation, water, soil, and wildlife in densely populated areas and adjacent lands. Urban forest management is the process through which urban forests are manipulated to provide multiple, long term benefits to urban society. Urban forestry research tries to find a balance between people's needs and nature's capabilities.

How big, or small, can an urban forest be; how far does its influence extend? The answers depend on what kind of urban forest management situation is involved. For example, if the situation deals with maintenance of natural forest stands in a 10-acre city park, then obviously the urban forest is defined by the boundary of the park. On the other hand, if a city is spraying urban waste water over large areas of nearby public forest lands, then the urban forest could comprise hundreds or thousands of acres.

The Problem

The impacts of people on urban forests and the impacts of those forests on people are complex, dynamic, and poorly understood. Yet, we know enough about them to recognize that many major problems of conservation and environmental management today stem from urban areas and their inhabitants. At the same time, decisions concerning environmental and conservation issues are being made by people who know only the environment of the city.

Specifically, the overall problem is: there is a lack of knowledge and methodology for maximizing the contributions of urban forests to human welfare.

R&D programs on this problem are essential if we are to prevent duplication of the environmental mistakes now prevalent in our core cities.

Many different disciplines relate to urban forest issues, and historically, each discipline has looked at its problem of "urban forestry" from its own professional perspective. Private urban tree companies are in business to increase the amenities of urban environments while making a profit (Chevron Chemical Company, nd). Utility companies strive to provide energy but at the same time improve the quality of the urban environment (Georgia Power Company, nd). The landscape architect is concerned with enhancing the natural beauty of urban landscapes (American Society of Planning Officials, 1968). The regional planner is involved with integrating urban forest values within the total urban-development process (Zube, et al, 1975). The horticulturist is concerned with the ecological and physiological aspects of individual trees and shrubs (Forest Service, 1976). The municipal watershed manager is faced with providing quality water on a watershed that is valued for many other uses ranging from parking lots to riding trails (Forest Service, 1976).

The urban forester looks at the long term management and valuation of the urban vegetative system (University of Massachusetts, 1971). The wildlife managers seeks to integrate wildlife in an urbanizing environment (University of Massachusetts, 1971), and invite wildlife to your backyard (Thomas, et al, 1973). The recreation professional attempts, among other things, to use natural environments to improve the quality of life for urban children (Forest Service, 1977). And so it goes.

Each of these and other professions has something to contribute to the management of vegetative systems in or near urban areas so as to increase the benefits that these systems produce. In the past, each of these professions, in effect, has been working somewhat independently of the other--resulting in different approaches to the management of urban vegetative systems.

Urban forestry, therefore, has emerged as a concept from a wide-range of disicplines that may sometimes disagree on the exact meaning of the term "urban forestry", but that have found a great deal of common interest in related problems.

Urban forestry has come of age and is recognized by the Society of American Foresters as a distinct branch of the forestry profession. In addition, the need for urban forestry programs has been recognized in Congress, and several State Foresters have initiated aggressive urban forestry management programs. The Forest Service commitment and concern for urban forestry issues is evident in the Human Community Development Element of the Resources Planning Act, and in the urban forestry research effort of the Pinchot Institute for Environmental Forestry Research, at the Northeastern Forest Experiment Station.

Because of the many and diverse professional interests involved, a precise definition of urban forestry, and the associated resources, has been difficult to develop. As a result, various terms have evolved: urban forestry, metro forestry, environmental forestry, community forestry; and others. Basically, however, as "urban forestry" has evolved, its underlying premise involved delivering benefits to people through management of forest resources in and near the city.

Some Benefits from Urban Forests

Urban forests are of considerable value for a variety of reasons. They add an aesthetic element to our engineered environment. By controlling wind and water erosion, they help stabilize the soil. Noise is reduced to more tolerable levels through the judicious use of trees and other plants in the vicinity of objectionable sounds.

Trees cleanse the atmosphere by precipitating and filtering out impurities and by adding oxygen to the air. It has been shown, for example, that the volume of carbon dioxide removed from the air by an 80-foot-tall beech tree each day is equivalent to that produced by two single-family dwellings. Reduction of air particulate pollutants of 7,000 or more dust particles per liter of air is possible along tree-lined streets.

In addition to providing cool and shady areas, trees tend to cool the surrounding air through evaporation and transpiration as well as through absorption of solar radiation. Some trees also have the

ability to absorb pollutants with minimal damage to the trees. Others, more sensitive to pollution, may serve as indicators of environmental degradation.

Trees and other plants can play an important role in enhancing buildings and other structures "architecturally" by defining or creating functional areas or other spaces, and by being used to reinforce design. They can also screen objectionable views, as well as provide privacy.

Trees have a considerable influence upon the energy flow of an ecosystem. Man-oriented ecosystems, such as cities, consume far more energy than they produce. Trees also reduce the consumption of respiratory energy that would otherwise be required by people in maintaining normal body temperatures.

The energy flow of trees may be a value that pinnacles over any other. Energy output from any one tree having a 50 m^2 crown has been calculated to be worth $128 per year in the United States (Lugo, et al 1971).

In addition, trees can add a monetary value to real property. For example, homes or building sites with trees usually sell more quickly and at higher prices than properties with no trees. Realty authorities have attributed an increased valuation per home to areas beautified by trees (Kielbaso, 1976). Trees may enhance the value per home by as much as 20% with average increases of 5% to 10% (Payne, 1975). Per tree value has been estimated at between $500 and $1,500 (Kielbaso, 1971).

Tree canopies have been shown to substantially reduce the air conditioning costs of homes, especially in southern climates. One study found this saving to amount to $88 per year per mobile home (Laechelt, 1974).

It should be noted, especially in a time of budget restrictions and dollar-stretching efforts, that while many public expenditures involve capital investment in projects which deteriorate in value, investment in management of urban forests involves investment in a commodity that increases in value.

Cooperation

An urban forestry R&D program can best proceed through strong cooperative efforts among universities, commercial organizations, and Federal, State, and local agencies.

Some of the R&D could best be conducted by interdisciplinary teams at universities, where the diverse disciplines required are already assembled. Besides most specializations within forestry, input and participation is needed from social scientists, agronomists, engineers, public health professionals, recreation and park specialists, educators, and others. A substantial number of the R&D objectives can be accomplished most successfully through cooperative efforts among professional arboriculturists and urban forestry organizations. Furthermore, existing Federal and State agencies are already established that could fulfill the requirements of some R&D objectives within their routine functions.

Furthermore, a significant body of knowledge has already been amassed by some state forestry organizations and others who have been actively engaged in urban forestry for a period of time. R&D efforts in the proposed program should coordinate with and build upon these efforts, rather than run parallel to them.

Past successful cooperative projects involving Forest Service scientists located on key university campuses, and working closely with faculty and students, have provided stimulus to university research and curriculum development in areas such as forest recreation and timber management. The same approach seems worth exploring for urban forestry issues. Supportive and qualified universities should be identified for potential project locations during the early development phases of any urban forestry R&D program.

Because of the limited funds and scientific knowledge available to attack urban forest R&D problems, any future cooperative efforts along these lines in research might well consider the administrative procedures used by the Pinchot Institute Consortium. The Institute serves as a viable working model of how university scientists and Forest Service researchers are coordinating their efforts--through workshops, symposia, and research--to increase our knowledge of urban forestry.

The development phase of any urban forestry R&D undertaking should consider opportunities that already exist in Federal-State relationships--the model for which already exists in the State and Private Forestry branch of the U.S. Forest Service.

THE R&D PLANNING TECHNIQUE

Overall Approach

This Research and Development (R&D) Program proposal was developed by university scientists, Forest Service researchers, and managers in Forest Service State and Private Forestry. Much of the initial planning was done through research programs within the Pinchot Institute of Environmental Forestry Research--a cooperative urban forestry research effort between the Forest Service and Northeastern universities.

Although a significant number of participants involved in this effort were from the Northeastern United States, they were nationally oriented in their perspective--as typified by the scope of their publications or administrative responsibilities. However, a large number of professionals from throughout the Nation reviewed an initial draft.

The Initial Planning Team contributed the overall structure of the R&D Program and basic items for inclusion. The Final Planning Team, composed of technical experts, completed the details for the initial draft. The draft was then reviewed by various experts in urban forestry throughout the Nation. This process seemed to be the best way to get suggestions from a large number of people at a relatively low cost. Individuals involved in this total effort are listed in Appendix V.

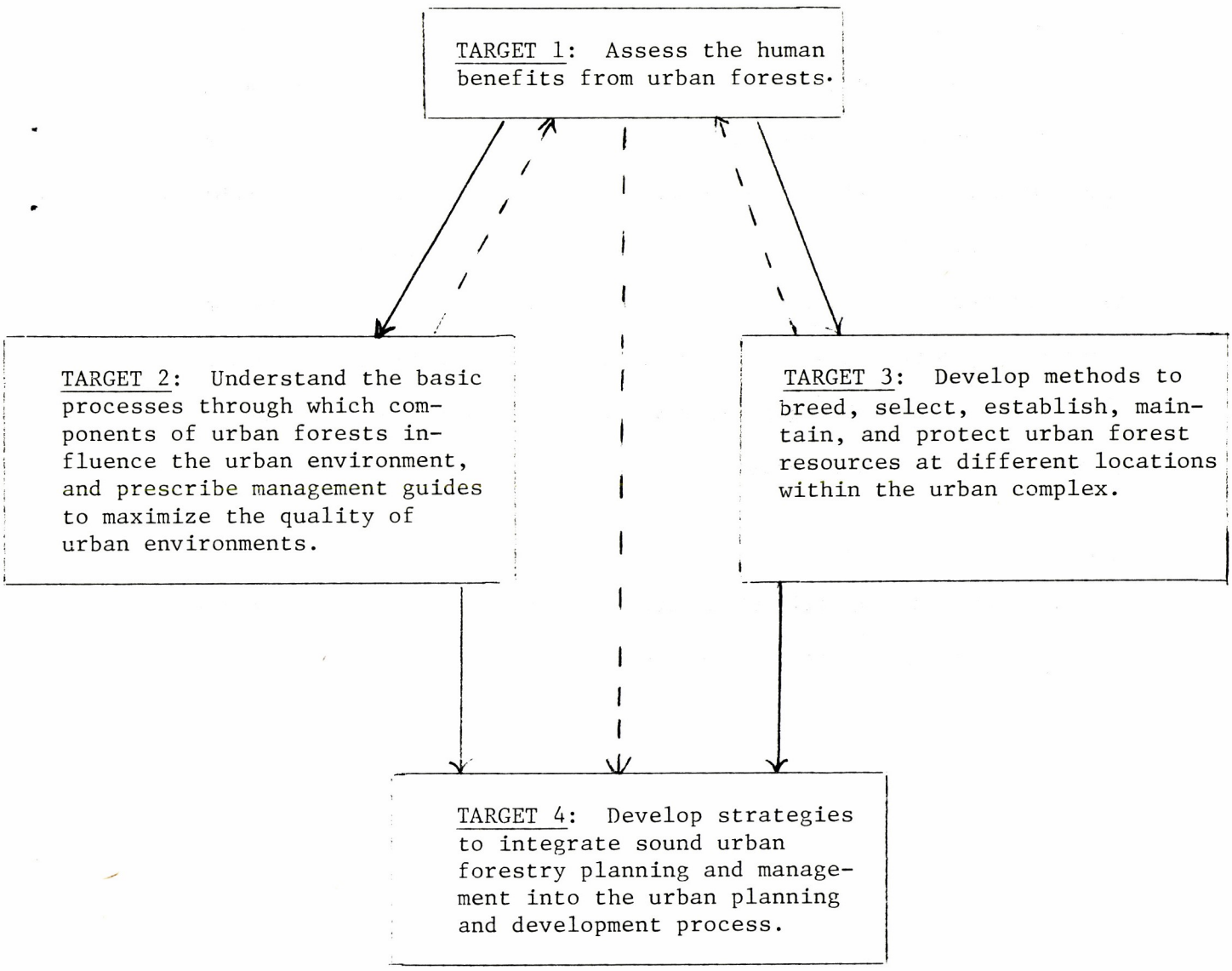
Relating R&D to Management Needs

This R&D program was planned in accordance with standard systems analysis techniques. First, we identified major targets of opportunity for R&D program (Figure 1). Next, each target was divided into logical subtarget areas; and within each subtarget area, research programs were described for solving the problems involved (Appendix I and II). In other words, a classification process was used for segregating problems into categories that were meaningful to various audiences such as: the urban resident, municipal planners, landscape architects, regional commissions, horticulturists, arborists, public decisionmaking bodies, and public and private agencies responsible for the management and maintenance of urban forests.

Targets

To solve the overall urban forestry problem, R&D needs to be directed at four major targets as outlined in Figure 1.

Figure 1.--Urban Forestry Research and Development Programs to Produce Technology that will Maximize the Contribution of Urban Forests to Society



*Targets 1 and 2 primarily reflect research activities; Targets 3 and 4 are primarily development (and some application) activities. However, all targets have some R&D involved.

Human Benefits from Urban Forests (Target 1).--Urban foresters manage components of the urban forest (such as vegetation, water, soil, and wildlife) to produce relevant human benefits.

The R&D activities in Target 1 seek to determine how, and to what degree, components of the urban forests can be correlated with relevant human benefits such as:

- Physical health
- Mental health
- Property values
- Employment stability and growth
- Conservation of energy
- Knowledge, through environmental education, about ecological processes

However, the benefits derived from urban forests may not always be positive ones. For example, in some urban forests the most immediate and pressing question may be the effect of the vegetation on the population of rats or stray dogs, rather than on enjoyable birds and wildlife. Likewise, rather than being pleasant and serene, some wooded urban areas may be foreboding and threatening to many city dwellers who see them as hangouts for muggers and derelicts--places of terror.

Nonetheless, whenever possible, it is important to establish dollar values (either + or -) for the benefits trees provide to urban residents. For example, as one urban forester pointed out in his review of the initial draft of this document:

> When I try to convince a developer to save trees around his proposed apartment complex, he says it is cheaper to clear off the trees. I must be able to compare two apartment complexes--equal except one has no trees and the other has mature, desirable, healthy trees in proper locations. I need to show how the forested apartments will mean more dollars in his pocket. I must be able to show him that the trees will save dollars by supporting a higher rental rate per unit, reducing the vacancy time between rentals, reducing the tenant turnover rate, reducing vandalism, and reducing energy consumption. Trees do this but I can not find the research to prove the dollars saved.

Management of Urban Forests to Enhance the Urban Environment (Target 2).--To manage the components of the urban forests so as to produce or increase human benefits, urban forest managers and planners must understand the biological and physical interrelationships among various components of the urban forests.

Target 2 involves R&D activities aimed at understanding the basic processes through which urban forests can be managed to help achieve desired qualities of the urban environment. Human benefits from urban forests are produced or increased by managing urban forests resources to affect:

- Visual Quality
- Climatic Conditions
- Home Energy Conservation
- Noise Reduction
- Air Quality
- Water Quantity and Quality
- Wastewater Disposal Systems
- Opportunities to View Urban Wildlife
- Recreation Opportunities
- Utilization of Urban Wood

Growth, Maintenance, Reproduction, and Management of Urban Forest Systems (Target 3).--The process of managing the vegetation in urban forests underlies the whole concept of urban forestry. The R&D activities in Target 3 concentrate on the management processes required to:

- Select and develop trees that tolerate the rigors of urban elements.
- Produce quality nursery stock.
- Plant, grow, improve, protect, maintain, and replace urban forests.
- Develop rotation criteria and management strategies.

This phase of the program encompasses a large number of opportunities for development (and potential application) programs in the total R&D effort. Programs here apply not only to growing vegetation but also to managing existing natural forests commonly found in small parcels or in a discontinuous pattern in and around urban areas.

Integrating Urban Forestry with Urban Planning and Development (Target 4).--Urban forestry issues and management solutions ultimately must mesh successfully with other relevant regional planning, development, and management processes. Of major importance in Target 4 are such items as:

- Strategies for incorporating urban forest management and protection procedures into a more comprehensive urban planning process.
- Information exchange systems and methods to insure public involvement in urban forestry management decisions.
- Monitoring technology and social change to evaluate their impacts on future urban forestry programs.
- Large scale applications to test ways of integrating urban forest management technology into community planning systems that emphasize natural ecological processes.

Relationship Among Targets

Targets are not totally independent; results of R&D programs in one target flow into or condition programs in subsequent targets. The interrelations among programs within targets is described in the Program Schedule (Appendix II).

In general, here is how it works.

- In Target 1, an urban forest benefit (B) is described either quantitatively or qualitatively.
- In Target 2, relationships among components (X, Y, Z, etc.) of the urban forest that effect benefit (B) are examined and formulated if possible: $B = f(X, Y, Z)$. Management guidelines are established based on the values of the coefficients for X, Y, and Z.
- In Target 3, management techniques are developed to increase (or reduce) X, Y, and Z so that B can be enhanced.
- And in Target 4, methods are explored for integrating benefit (B) into the urban planning process.

Not all R&D programs described in Appendix II follow this sequence because some problems of urban forestry research are fairly well solved (noise research for example). Entries in Appendix II reflect these facts in terms of the dollars, people, and kinds of activities assigned to the individual problems.

Classification of Programs within Targets

A research program is a technical approach, within the total R&D effort, that is appropriate for budgeting and progress accountability. Successful completion of all R&D programs within all targets and subtargets would meet all R&D objectives.

Each program was assigned to one of four categories

1. Lead Programs: The main effort needed to solve associated problems within a specific subject-matter area.
2. Optimizing Programs: Those efforts that would optimize solutions to problems in category 1.
3. Safeguard Programs: Substitute technical approaches for the programs in the Lead and Optimizing categories.
4. Supplementary Programs: These programs are "high risk" or "far-out" applied research; others may be long range fundamental research. Nevertheless, results from these programs could bring about major changes in the Lead Programs, but the total contribution of the program is not clear or unknown.

Any one target or subtarget does not necessarily contain all four kinds of programs.

As the R&D progresses, findings in any of the program categories may point up inadequacies in the logic in the Lead Programs. Furthermore, Programs in the Optimizing, Safeguard, and Supplementary categories

may become part of the Lead category; or some of the results of Safeguard, Optimizing, and Supplementary Programs may point to new approaches for inclusion in the Lead Programs.

The Program Flow, involving all 97 R&D programs, is found in Appendix I.

Program Schedule

The Program Schedule (Appendix II) is the basic working document of the overall R&D effort. The Program Schedule provides the basis to:

1. Determine budget estimates required to meet various program objectives.
2. Consider the impact on management of different levels of program funding.
3. Evaluate implications of expected accomplishments.
4. Identify milestones in various programs.
5. Monitor progress of all programs.
6. Segregate the total R&D effort into packages for different levels of funding.

Estimates of the professional person years (PPY's) and dollars required for each program are shown in the Program Schedule. Professional person years were used rather than scientist years (SY's), to reflect the fact that the R&D program will be implemented by a broad spectrum of professionals--including research scientists, land managers, regional planners, and others.

The criteria used to judge potentially productive research may appear to be based solely on the chances that practical management methods or products would result. While this is an important consideration, it does not always follow that R&D activities should be avoided if longtime horizons seem evident before practical results would emerge. In any future revision of this R&D planning document, programs should be examined carefully for their long term significance to both research and management before they are disqualified solely because of dollar of PPY limitations.

COSTS, PRIORITIES, AND REGIONAL DIVERSITY

Costs

An accelerated 10-year program, at a total cost of about 15.7 million dollars a year, can accomplish most of R&D programs outlined in this report (Appendix III).

Target	Total (Millions)
1	15.8
2	69.6
3	55.4
4	16.1
	156.9

However, because new and emerging problems will undoubtedly continue to appear as they have in the past, some continuing research beyond this 10-year period probably will be essential to deal with changes in the needs of urban populations, emerging urban forestry issues, and changes in urban land use.

In analyzing urban forestry R&D needs it was important to first consider the overall magnitude of the problem and the associated costs before trying to establish priorities within the program. Otherwise, one is never quite sure if something important has been omitted in the long range planning involved in an effort such as this.

It seems highly unlikely that about 15.7 million dollars a year for 10 years would be forthcoming for this R&D program. Therefore, alternative R&D programs were developed for budgets of 3, 6, and 9 million dollars per year (Appendix IV). Other budgets can be developed, if needed, by using the priorities found in Appendix III.

Incidently, the National Program of Research for Forest and Associated Range Lands (U. S. Department of Agriculture, n.d.) suggests that the research budget for timber management alone should be 396 scientist years x $70,000 per scientist, or almost 28 million--just for 1975. In light of those kinds of suggested research expenditures, a 10-year program costing 15.7 million/year for air, water, soil, wildlife, and recreation research in urban environments may not seem too unrealistic in some respects.

Priorities

The assignment of an R&D activity to one of four types of program classifications, (lead, optimizing, safeguard, or supplementary) broadly specifies the priority of that activity for planning purposes and insures continuity of program content. But it is still necessary to assign priorities among subtargets. To provide a logical structure to the R&D program, any future decisions regarding assignment of dollars and PPY's should be made on the basis of priorities among subtargets.

A group of experienced urban forestry researchers and managers used the following system to set priorities throughout the entire R&D program.

Subtargets were coded as:

1 = Essential

2 = Very Important

3 = Important

to the successful accomplishment of an urban forestry R&D program.

The basis for assigning a 1, 2, or 3 value to subtargets within each of the four target areas was as follows:

Target Area	Basis for classifying the subtarget as a 1, 2, or 3
1	How important the subtarget information is for making good decisions about urban forest planning or management.
2	The worth or value (payoff) of the subtarget subject area to society.
3	The immediacy of application and how critically urban foresters need the information in the subtarget area to provide a quality urban forest environment.
4	Potential contribution or effectiveness of the related activities in the subtarget for getting R&D results applied.

Priority values are summarized in Appendix III.

Regional Diversity

Program orientation not only depends on dollars available, talent, existing programs, and opportunities for cooperative efforts, but also on variations in vegetation, soil, wildlife, and water conditions throughout the country. For purposes of this report, the following classification was used for defining geographic orientation of the total R&D effort:

1. Northeast
2. Southeast
3. Midwest
4. Southwest
5. West Coast
6. Rocky Mountains
7. Nonregional
8. All Regions

Appendix III summarizes the recommended program orientation by regions of the country.

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PROGRAM FLOW

TARGET 1 ASSESS THE HUMAN BENEFITS FROM URBAN FORESTS

SUBTARGET 1.1 Determine the relative levels of social well-being among urban areas with varying conditions of urban forest resources.

Lead Program

1.1.1 Compare the social well-being among urban areas with different levels of urban forest resources and environmental conditions.

Optimizing Program

1.1.2 Evaluate standards of urban environment maintenance.

SUBTARGET 1.2 Understand the social and psychological interactions among urban people, urban forest vegetation, and other components of the urban environment.

Lead Program

1.2.1 Expand knowledge of basic human needs, stress levels, perceptions, and other human behavior in relation to urban forests and environments.

1.2.2 Measure the benefits to urban people derived from alternative states of the urban forest environment.

Optimizing Program

1.2.3 Identify divergent urban publics in relation to their concerns about, and the meanings they ascribe to urban forests.

SUBTARGET 1.3 Assess demand for and benefits produced from urban forest-related abatement of noise, air, and water pollution.

Lead Program

1.3.1 Determine the physical health benefits from pollution reduction attributable to urban forests.

1.3.2 Measure deterioration in the urban physical environment attributable to lowered urban forest productivity caused by air and water pollution.

SUBTARGET 1.4 Assess the demand for aesthetic enhancement and increasing recreational opportunities through urban forest management.

Lead Program

1.4.1 Measure the demand functions for and benefits from enhancement of urban aesthetic quality and recreation in urban forests.

Optimizing Program

1.4.2 Develop methodology for projecting the demand for aesthetic enhancement and urban forest recreation.

SUBTARGET 1.5 Assess demand for and benefits from climate moderation and energy conservation from urban forests.

Lead Program

1.5.1 Quantify the energy consumption savings possible from climate moderation and home energy savings through urban forest management.

Safeguard Program

1.5.2 Determine the demand for urban climate moderation and resulting benefits from urban forest management.

SUBTARGET 1.6 Assess the benefits from and demand for urban forest-based educational programs.

Lead Program

1.6.1 Describe the increases in productivity and environmental awareness obtainable through urban forest educational programs.

1.6.2 Assess the recreational values derived from urban forest-based educational opportunities.

SUBTARGET 1.7 Assess the demand for wood and water production from urban forests

Lead Program

1.7.1 Assess the demand for and marketability of urban-grown wood.

1.7.2 Determine present and future demands for water from municipal watersheds.

1.7.3 Measure the savings in water treatment and supply costs possible through increasing the use of urban forests for water production.

Optimizing Program

1.7.4 Identify the recreational, educational and aesthetic enhancement benefits resulting from increased urban water supply.

TARGET 2 UNDERSTAND THE BASIC PROCESSES THROUGH WHICH URBAN FORESTS INFLUENCE THE URBAN ENVIRONMENT AND PRESCRIBE MANAGEMENT GUIDES TO IMPROVE THE QUALITY OF URBAN ENVIRONMENTS.

SUBTARGET 2.1 Understand the basic processes of how urban forests influence air quality and develop management guides to maximize this benefit.

Lead Program

2.1.1 Determine the effects of ambient air pollution concentrations on urban forests.

2.1.2 Determine impacts of precipitation on urban forest ecosystems.

2.1.3 Define effects of acid precipitation on natural ecological processes in urban environments.

2.1.4 Determine how urban trees serve as biological sinks for particulate pollutants.

2.1.5 Determine role of urban trees as biological sinks for gaseous pollutants.

Optimizing Program

2.1.6 Determine impact of heavy metal particulates on nutrient cycling in urban soils.

2.1.7 Determine effects of ambient concentrations of air pollutants on cellular processes.

SUBTARGET 2.2 Understand the basic processes of how urban forests reduce noise and develop management guidelines to maximize this benefit.

Lead Program

2.2.1 Determine effects of urban forests on sound transmission.

2.2.2 Determine interaction of forests, terrain, and urban structures on noise transmission.

SUBTARGET 2.3 Understand the basic process of how urban forests moderate climate and develop management guidelines to maximize human comfort and health with urban forests.

Lead Program

2.3.1 Determine effect of trees on microclimatic variables by using indices of human thermal comfort.

2.3.2 Determine relationships between urban vegetation systems and mesoclimate.

2.3.3 Determine effects of trees and associated vegetation on microclimate through application of human comfort models to climatic conditions.

Optimizing Program

2.3.4 Determine the effect of urban forests on albedo of urban areas, and refine existing estimates of this parameter.

SUBTARGET 2.4 Understand the basic processes of how urban forests influence home energy consumption and develop management guidelines to maximize this benefit.

Lead Program

2.4.1 Using wind tunnel techniques, quantify the effect of windbreaks on reducing infiltration of air into buildings.

2.4.2 Quantify the effect of tree windbreaks on urban airflow with full-scale field tests.

2.4.3 Quantify the effects of urban forests on energy consumption in buildings.

Safeguard Program

2.4.4 Quantify the effect of tree shade on energy consumption in buildings.

SUBTARGET 2.5 Understand the basic processes of how urban forests influence municipal water quantity and quality and develop management guidelines to maximize this benefit.

Lead Program

2.5.1 Determine present and future supply of water from municipal and urban forest watersheds.

2.5.2 Develop and improve methods for managing municipal watersheds to optimize usable water yield.

2.5.3 Evaluate vegetation management alternatives for maintaining and improving water quality.

2.5.4 Determine effects of other uses on municipal watersheds as related to water quality.

SUBTARGET 2.6 Investigate the feasibility of using urban forest land for recycling municipal wastewater and sludge, and develop management guidelines to maximize such benefits.

Lead Program

2.6.1 Develop models that describe and predict the effects of recycling municipal wastewater and sludge through urban forest ecosystems.

2.6.2 Determine effects of wastewater and sludge on public health and wildlife.

2.6.3 Develop new application methods suitable for wastewater and sludge recycling on urban forest lands.

2.6.4 Develop guidelines for site selection and management to prevent surface runoff and erosion of treated lands.

2.6.5 Develop guidelines for formulating optimal loading and application rates.

Optimizing Program

2.6.6 Determine optimum forest management system to accept and renovate municipal wastewater and sludge.

2.6.7 Develop and improve methods for reclaiming disturbed lands with municipal wastewater and sludge.

Safeguard Program

2.6.8 Develop new empirical methods of evaluating health hazards connected with recycling wastewater and sludge on urban forest lands.

SUBTARGET 2.7 Understand the basic processes of how urban forests provide wildlife habitat and develop management guidelines to maximize desirable (and minimize undesirable) wildlife-people interactions.

Lead Program

2.7.1 Investigate ways in which urban forests affect distribution and density of urban wildlife.

2.7.2 Develop methods for managing urban forest resources to maximize desirable people-wildlife interactions.

Safeguard Program

2.7.3 Evaluate the impacts of forest and range (wildlife) management systems on urban nongame wildlife habitats and populations.

Supplementary Program

2.7.4 Protect and enhance threatened and endangered wildlife (Coordinate with Program to Protect and Enhance Threatened and Endangered Species of Wildlife-June 23, 1975).

SUBTARGET 2.8 Understand how urban forests can be used to improve educational opportunities and develop systems to enhance educational benefits of urban forests.

Lead Program

2.8.1 Determine the role that urban forests could play in educational systems.

2.8.2 Experiment with alternative modes of educational presentations to determine ways to improve presentation effectiveness.

2.8.3 Find ways to improve the effectiveness of urban forest educational efforts.

SUBTARGET 2.9 Understand how urban forests contribute to the visual quality of urban landscapes and develop management systems that maximize this relationship.

Lead Program

2.9.1 Understand how urban forests contribute to the visual quality of urban landscapes.

2.9.2 Develop management programs to maximize the contribution of urban forests to the enhancement of regional urban landscape quality.

Optimizing Program

2.9.3 Understand how resource professionals, concerned with developing and managing urban forests, perceive urban forestry and its relationship to the visual quality of urban landscapes.

SUBTARGET 2.10 Understand how urban forests contribute to outdoor recreation opportunities and experiences, and develop management systems that maximize this relationship.

Lead Program

2.10.1 Improve or develop methods to inventory existing and potential supplies of urban forest recreation environments.

2.10.2 Improve or devise methods for managing and maintaining urban forest recreation resources.

SUBTARGET 2.11 Understand how urban forests and wastewood can be utilized, and develop management systems that maximize utilization.

Lead Program

2.11.1 Develop methods to measure the supply of wood and wastewood in urban areas.

2.11.2 Develop methods to decrease the cost of utilizing wood and wastewood in urban areas.

TARGET 3 DEVELOP METHODS TO BREED, SELECT, ESTABLISH, MAINTAIN, AND PROTECT URBAN FOREST RESOURCES AT DIFFERENT LOCATIONS WITHIN THE URBAN COMPLEX.

SUBTARGET 3.1 Define soil, water, and site requirements of forest vegetation throughout the urban complex.

Lead Program

3.1.1 Develop methods to identify and improve environmental components critical to the establishment and growth of urban forest vegetation.

3.1.2 Define urban soil-plant-atmospheric moisture relationships.

3.1.3 Develop the use of mycorrhizae to increase survival and growth of urban forest species.

SUBTARGET 3.2 Select and develop urban forest vegetation capable of growing at specific locations throughout the urban complex.

Lead Program

3.2.1 Develop criteria and strategies for selecting urban forest and associated woody vegetation for planting at specific locations within the urban complex.

3.2.2 Develop improved varieties of urban forest vegetation adapted to four regions of the U.S. and to specific uses and sites within each region.

3.2.3 Test and monitor performance of cultivars and improved varieties under conditions of urban stress (Link to Subtarget 4.5).

Optimizing Program

3.2.4 Determine intraspecific patterns of genetic variation in useful traits among individuals, populations, and varieties of important urban forest species (Link to Subtarget 3.2.2).

3.2.5 Compare effectiveness of different breeding strategies for achieving genetic gains in important urban forest species and traits (Link to Subtarget 3.2.2).

Safeguard Program

3.2.6 Evaluate opportunities for obtaining improved varieties by introducing species and cultivars from other countries.

SUBTARGET 3.3 Establish and manage urban forest vegetation capable of growing at specific locations throughout the urban complex.

Lead Program

3.3.1 Develop methods to establish urban forests for specific purposes at specific locations.

3.3.2 Develop methods to manage urban forests.

Optimizing Program

3.3.3 Adapt or develop methods for maximizing natural reproduction of urban forests.

SUBTARGET 3.4 Develop control systems for major insect and disease problems in urban forest management programs.

Lead Program

3.4.1 Determine control opportunities for problems caused by insect and disease interactions.

3.4.2 Determine methods to reduce impacts of major infectious diseases in urban forests.

3.4.3 Determine methods to reduce urban stresses and prevent consequent dieback, declines and physiogenic disorders.

3.4.4 Develop cultural and chemical methods to reduce impacts of major insect pests.

3.4.5 Develop biological controls to reduce impacts of major insect pests.

Optimizing Program

3.4.6 Develop regional pest management models for major urban forest insects and diseases.

3.4.7 Determine methods to measure stress-induced reductions in host vigor.

3.4.8 Determine the role of environmental and climatological parameters influencing development, survival and behavior of major insects and diseases.

Supplementary Program

3.4.9 Determine the effects of environmental pollutants on major pest insects.

SUBTARGET 3.5 Develop methods to protect urban forests from detrimental impacts of fire, animals, and man's activities.

Lead Program

3.5.1 Determine nature and extent of wildfire problems at the urban-rural forest interface and develop appropriate prevention programs.

3.5.2 Adapt existing wildland fuel management alternatives and, where necessary, develop new fuel management techniques for urban forests.

3.5.3 Develop firefighting equipment, techniques, and organization systems for use on large destructive fires at the urban-rural interface.

3.5.4 Develop methods to protect urban forests vegetation from the detrimental influences of animals and man's activities.

SUBTARGET 3.6 Develop an assessment and inventory system to monitor information necessary to carry out long term urban forest management programs.

Lead Program

3.6.1 Develop, test, and establish an urban forestry management data monitoring system.

TARGET 4 DEVELOP STRATEGIES TO INTEGRATE SOUND URBAN FORESTRY PLANNING AND MANAGEMENT INTO THE URBAN PLANNING AND DEVELOPMENT PROCESS.

SUBTARGET 4.1 Evaluate the impact of factors related to the urban development process on the ability of urban forests to deliver benefits.

Lead Program

4.1.1 Identify influence of social, economic, and cultural factors on the ability of urban forests to deliver benefits.

4.1.2 Determine impact of Federal, State, and local government development policies, and judicial systems on the ability of urban forests to deliver benefits.

4.1.3 Determine past and potential impact of changing demands for urban services (transportation, housing, utilities, etc.) on the ability of urban forests to deliver benefits.

SUBTARGET 4.2 Develop and test land use control methods that maximize the ability of urban forests to deliver benefits.

Lead Program

4.2.1 Design land use control systems and policies that maintain and protect urban forest and related resources, as well as protect man's developments.

SUBTARGET 4.3 Develop administrative systems to organize and implement urban forest management programs and policies.

Lead Program

4.3.1 Define systems for administering urban forestry management programs.

SUBTARGET 4.4 Determine influence of technological and social change on the ability of urban forests to provide continuing benefits.

Lead Program

4.4.1 Monitor technological and social changes that are likely to influence urban forest delivery systems.

SUBTARGET 4.5 Develop and test programs for disseminating sound urban forest management information and stimulating involvement in the urban forestry planning and decision-making system.

Lead Program

4.5.1 Develop information and education programs for various factors involved in the urban forest planning system.

4.5.2 Develop theory and methods for involving urban residents in the urban forestry planning and management decisionmaking process.

4.5.3 Design and conduct workshops, symposia, and other methods for informing urban land use decision makers about urban forest benefits and sound management practices, and for informing urban forest managers about effective techniques for securing public involvement.

SUBTARGET 4.6 Conduct tests of alternative methods to integrate urban forestry into the urban planning and development process.

Lead Program

4.6.1 Conduct short term pilot tests of urban forestry management programs in urban areas where success is potentially high.

4.6.2 Establish long term tests of urban forest management to monitor the long term effects on environmental elements and human benefits.

APPENDIX II - PROGRAM SCHEDULE

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
TARGET 1						
1. Assess the human benefits from urban forests.						
1.1 Determine the relative levels of social well-being among urban areas with varying conditions of urban forest resources.						
Lead Program						
1.1.1 Compare the social well-being among urban areas with different levels of urban forest resources and environmental conditions.	Measure the social welfare opportunity cost ("loss," indicated by levels of police, court, welfare, health, etc., costs) and the urban forest maintenance cost (including resource opportunity costs) and measure the relationship between variations of these costs and the conditions of the forest resource among urban communities. (4PPY) ($400M)	Measure the relationship between environmental conditions (including climate, air and water quality, aesthetic quality, and recreational opportunity, etc.) and the social loss and urban forest maintenance cost among urban communities. Identify the relative importance of each environmental condition as a contributor to loss and maintenance cost. Conduct benefit/cost analyses which may show that attempts at urban forestry may not be justified by the benefits to be derived. (4PPY) ($400M)			Indication of the relative improvement in human welfare obtainable from urban forest enhancement and indication of aspects of the urban forest resource showing the most potential benefit from intensive research and management attention. Identification of elements in the urban forest environment that show most highest payoff for intensive research. (8PPY) ($800M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
Optimizing Program						
1.1.2 Evaluate standards of urban environment maintenance.	Inventory existing standards of urban environmental quality and evaluate these relative to obtainable welfare levels (from results of 1.1.1, contribution to social well-being).	Based on contribution to social well-being versus cost of urban forest maintenance, develop standards of environmental quality, where currently non-existent.				Standards of urban environmental quality with applicability to accomplishment of research Targets 2 and 3.
	(2PPY) ($200M)	(3PPY) ($300M)				(5PPY) (500M)
1.2 Understand the socio- and psychological interactions between urban people, urban forest vegetation, and other components of the urban environment.						
Lead Program						
1.2.1 Expand knowledge of basic human needs, stress levels, perceptions, and other human behavior in relation to urban forests and environments.	Revise and expand methods and knowledge of basic human needs, stress levels perceptions, and other behavior as related to urban environments and forests. Identify how urban forests contribute to human satisfaction levels.	**Continue.** Identify effects of urban forests upon human behavior patterns by locations within cities.	Continue.			Knowledge of the influence of urban environments and forests on the lives of urban dwellers as a basis for research and developing programs concerned with environmental education, aesthetics of urban landscapes, outdoor recreation, urban wildlife, climatic influences, and public involvement.
	(5PPY) ($500M)	(5PPY) ($500M)	(4PPY) ($400M)			(14PPY) ($1400M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
Lead Program						
1.2.2 Measure the benefits to urban people derived from alternative states of the urban environment.	Evaluate methods for measuring needs (self-esteem, stimulation, sense of community, territoriality, environmental mastery, and achievement of good life). Develop ways to measure mental health.	Continue FY 1-2 activities and begin to develop data base indicating levels of benefits and mental health in a wide array of urban communities.	Measure relationships between benefit levels and mental health and the state (quality) of components of the urban environment, including pollution loadings, climate, aesthetic quality, and degree of recreational opportunity.			Knowledge of the contribution to socio-psychological benefits from control of the components of the urban environment.
	(4PPY) ($400M)	(6PPY) ($600M)	(6PPY) ($600M)			(16PPY) ($1600M)
Optimizing Program						
1.2.3 Identify divergent urban publics in relation to their concerns about, and the meanings they ascribe to urban forests.	Adapt or develop methods for identifying various urban publics or special interest groups and for specifying their perceptions of concerns about urban forests and the meanings they assign to them.	Continue.	Complete studies.			Description of various urban publics concerns for and meanings assigned to urban forests.
	(5PPY) ($500M)	(5PPY) ($500M)	(4PPY) ($400M)			(14PPY) ($1400M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
1.3 Assess demand for and benefits produced from urban forest-related abatement of noise, air, and water pollution.						
Lead Program						
1.3.1 Determine the physical health benefits from pollution reduction attributable to urban forests.	Review procedures for indexing physical health and synthesize existing information concerning effects of air, water, and noise pollution on health. Identify urban areas where pollution is critically affecting health.	In cooperation with other agencies and private concerns, develop systems for monitoring health conditions and for predicting areas where pollution reduction may be most beneficial.	Continue FY 3-4 activities and quantify relationships between health and pollution loadings.	Develop methods for estimating current and predictions of future values of increased health in relation to urban forests.		Identification of the health increase benefits possible through pollution reduction attributed to presence of urban forests.
	(2PPY) ($200M)	(2PPY) ($200M)	(2PPY) ($200M)	(2PPY) ($200M)		(8PPY) ($800M)
1.3.2 Measure deterioration in the urban physical environment attributable to lowered urban forest productivity caused by air and water pollution.	Extend knowledge on ways to measure the deterioration of urban manmade structures caused by air and water pollution and provide means for valuing resultant depreciation and maintenance costs.	Continue FY 1-2 activities and begin work on predicting the deterioration or defacement under alternative future pollution loadings. Begin work on assessment of value lost from reduced urban forest productivity resulting from pollution.	Continue FY 3-4 activities. Develop models to predict ways to reduce maintenance costs of manmade structures through urban forests management to reduce air pollution.	Review existing economic methods for measuring the demand for pollution reduction and test these methods for applicability to predict demand for urban forest-related pollution reduction. Develop appropriate demand models.		Quantify the savings possible from reducing effects of pollution on urban structures through use of urban forests and develop models to predict future demand for such savings.
	(2PPY) ($200M)	(2PPY) ($200M)	(2PPY) ($200M)	(2PPY) ($200M)		(8PPY) ($800M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
1.4 Assess the demand for aesthetic enhancement and increasing recreational opportunities through urban forest management.						
Lead Program						
1.4.1 Measure the demand for and benefits from enhancement of urban aesthetic quality and recreation in urban forests.	Review existing demand analysis methodologies including property value modeling, and adapt it to measuring demand for urban forest aesthetic quality and recreational opportunity. Develop indices of aesthetic quality and recreational consumption. (4PPY) ($400M)	Refine demand measurement methodology and apply to various urban situations. Develop models which are dependent on readily available, low-cost data. (4PPY) ($400M)	Relate resultant demand data to the socio-psychological needs findings from 1.2.1 and 1.2.2. Determine relationship between urban health and urban forest opportunities for aesthetic enjoyment and recreation. (4PPY) ($400M)	Develop and test innovative demand measurement methods. Identify indices of urban forest aesthetic quality and recreation opportunities that contribute to health. (4PPY) ($400M)	Conclude FY 7-8 activities and compare the demand estimates from FY 3-8 with decisions currently being made by public and private land-use decision-makers. Use these comparisons to recommend urban development and forest policy changes that will maximize mental and physical health. (4PPY) ($400M)	Models for estimating demand for aesthetic quality and urban forest recreation in order to maximize urban forest's contribution to health of urban residents. (20PPY) ($2000M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
Optimizing Program						
1.4.2 Develop methodology for projecting the demand for aesthetic enhancement and urban forest recreation.			Develop systems for maintaining up-to-date data for use with models developed in program 1.4.1.	Refine data management systems and seek to reduce the costs of updating the data. Explore possibilities for merging with other maintained urban data bases.	Provide 5- and 10-year projections of aesthetic quality and urban forest recreation demand for major types of urban areas, and develop prototype analysis and data management systems.	Provide forecast of demand for aesthetic enhancement and urban forest recreation.
			(2PPY) ($200M)	(2PPY) ($200M)	(2PPY) ($200M)	(6PPY) ($600M)
1.5 Assess demand for and benefits from climate moderation and energy conservation from urban forests.						
Lead Program						
1.5.1 Quantify the energy consumption savings possible from climate moderation and home energy savings through urban forest management.	Under controlled conditions, measure the energy savings resulting from reduction of wind velocities.	Continue FY 1-2 activities and begin measurement of energy savings resulting from moderation of solar radiation and air temperature.	Conclude FY 3-4 activities.			Measurement of energy consumption savings obtainable from climate modification.
	(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)			(12PPY) ($1200M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
Safeguard Program						
1.5.2 Determine the demand for urban climate moderation and resulting health benefits from urban forest management.	Identify ways through which people express demand for climate moderation and develop a standard method for indexing willingness to pay.	Conduct exploratory research to determine the extent of relationship between climate and mental and physical health. Identify climatic conditions causing mental or physical stress.	Continue FY 3-4 activities and develop ways to measure the contributions to climate modification to good health.	Estimate demand functions for climate moderation and establish procedures for periodic recalibration of these functions.		Provide estimates of the worth of various levels of urban climate modification and identify opportunities for improving health through climate modification using urban forests.
	(2PPY) ($200M)	(2PPY))$200M)	(2PPY) ($200M)	(2PPY) ($200M)		(8PPY) ($800M)
1.6 Assess the benefits from and demand for urban forest-based educational programs.						
Lead Program						
1.6.1 Describe the increases in productivity and environmental awareness obtainable through urban forest educational programs.	Review existing techniques for measuring attitude, human productivity, and environmental awareness, and use them to assess the positive effects attainable by educating various population segments through use of urban forests as outdoor classrooms.	Continue FY 1-2 activities and identify attitudes and/or behavior which are particularly susceptable to change through urban forestry based education programs.	Compare the effectiveness of alternative educational techniques for achieving educational benefits.	Develop predictions of the long run benefits from alternative levels of urban forest based education programs.		Specify levels of benefits from urban forestry educational programs.
	(3PPY) ($300M)	(3PPY) ($300M)	(2PPY) ($200M)	(2PPY) ($200M)		(10PPY) ($1000M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
1.6.2 Assess the recreational values derived from urban forest-based educational opportunities.	Through analysis of motivations for recreation participation, describe the degree to which forest education contributes to entertainment or recreation-related benefits.	Devise ways to enhance the recreational benefits of urban forest education to achieve greater participation.				Predict the recreation benefits likely from urban forestry education programs.
	(2PPY) ($200M)	(2PPY) ($200M)				(4PPY) ($400M)
1.7 Assess the demand for wood and water production from urban forests.						
Lead Program						
1.7.1 Assess the demand for and marketability of urban-grown wood.	Evaluate the quality, possible uses, and profit returns possible through harvesting and/or salvaging urban-grown wood, including wastewood. Identify innovative uses.	Develop generally applicable techniques for assessing the marketability of urban wood.				Measurement of the market potential for urban-grown wood.
	(3PPY) ($300M)	(3PPY) ($300M)				(6PPY) ($600M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
1.7.2 Determine present and future demands for water from municipal watersheds.	Inventory. Compile available municipal watershed use data.	Develop methods to predict future demand based on current use trends, water conservation practices, population dynamics, and technological changes.	Test and refine prediction methods.	Complete models and make predictions. Revise as appropriate.		Determine role that municipal watersheds can play in meeting water demand.
	(2PPY) ($200M)	(2PPY) ($200M)	(1PPY) ($100M)	(1PPY) ($100M)		(6PPY) ($600M)
1.7.3 Measure the savings in water treatment and supply costs possible through increasing the use of urban forests for water production.	Review techniques for predicting water quantity and quality effects from varying forest conditions. Adapt the techniques to urban forest situations.	Describe the relationships between costs of water production and treatment and modifications of urban forest conditions.	Continue FY 7-8 activities and develop general evaluations of the returns from using urban forests to enhance water supply in different regions of the U.S.			Specify the reduction on water supply costs possible from urban-forest management.
	(3PPY) ($300M)	(4PPY) ($400M)	(4PPY) ($400M)			(11PPY) ($1100M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
Optimizing Program						
1.7.4 Identify the recreational, educational, and aesthetic enhancement benefits resulting from increased urban water supply.	Assess the importance of impounded and running water to aesthetic quality and to participation in urban recreation activities. Describe relationships for predicting increases in aesthetic quality and recreation opportunity obtainable from increased quantities of water. (2PPY) ($200M)	Evaluate and describe the educational opportunities resulting from more readily available streams and impoundments in urban areas. Continue FY 1-2 activities. (2PPY) ($200M)				Predictions of aesthetic, recreation and education benefits from enhanced urban water supply. (4PPY) ($400M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
TARGET 2						
2. Understand the basic processes through which urban forests influence the urban environment and prescribe management guides to improve the quality of urban environments.						
2.1 Understand the basic processes of how urban forests influence air quality and develop management guides to maximize this benefit.						
Lead Program						
2.1.1 Determine the effects of ambient air pollution concentrations on urban forests.	Assess threshold levels of trees to measured concentrations of aerial toxicants for a predetermined period of exposure. Assess tree response patterns to air pollutants as modified by genetic factors.	Continue to establish dose-response curves for trees in controlled environments. Integrate climatic and edaphic factors with above exposures. Determine significance of temperature, humidity, and soil characteristics on tree responses to air pollutants. Ascertain degree of genetic controls of pollution tolerance.	Study long term effects of ambient pollution on trees established in field chambers. Define parameters of climatic and edaphic responses from both laboratory and field studies and relate to possible impact on urban trees. Test pollution reactions of genetic clones.	Characterize growth, yield, and productivity of trees under a broad spectrum of urban environmental conditions. Asses impact of urban stresses and air pollution on plant communities, population changes, competitive or survival ability, and alternations in successions of plant parameters.	Continue developing procedures for inventory of air pollution effects on urban tree experimental plantings.	Improved understanding of the relations between air pollution and urban forest ecosystems.
	(3PPY) ($300M)	(3PPY) ($300M)	(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)	(18PPY) ($1800M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
2.1.2 Determine impacts of precipitation on urban forest ecosystems.	Initiate precipitation network sites in both urban and rural locations and conduct chemical analyses of dry and wet deposition. Characterize physical and chemical kinetics of NO2 and SO2 reactions in clean and contaminated atmospheres.	Continue monitoring network. Quantify NO2 and SO2 into secondary pollutant products as conditioned by environmental changes. Improve, expand, standardize and coordinate global emission inventories of natural and anthropogenic sources which contribute to acid precipitation.	Develop transport models to predict trends and reactions in urban atmospheres. Provide information on transport mechanisms from major pollutant sources and over diversified terrain to urban communities. Clarify acidic chemistry and transformation reactions in atmosphere.	Integrate precipitation data and technology into operational procedures.		Better understanding of the environmental impacts of wet and dry precipitation on urban forest ecosystems.
	(3PPY) ($300M)	(3PPY) ($300M)	(6PPY) ($600M)	(6PPY) ($600M)		(18PPY) ($1800M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
2.1.3 Define effects of acid precipitation on natural ecological processes in urban environments.	Literature review on importance of hydrogen ions on aquatic systems. Establish permanent network for monitoring precipitation chemistry. Initiate permanent network for measuring volume discharges, chemistry, and biology of freshwater systems in urban environments. Provide baseline data on soil processes. Establish network to monitor air pollution and acidity deposition.	Conduct in-depth studies involving biological, chemical, and hydrological interrelationships of aquatic systems with respect to varying levels of acidic accreations, heavy metals, and nutrient ions in precipitation. Improve understanding of acid precipitation on biological processes. Investigate effects of mineral weathering and clay development from acidity. Continue monitoring network. Define tree species tolerance and reaction to acid precipitation.	Continue network sampling, and also the nature and extent to which aquatic life responds to acid precipitation. Determine importance of acid precipitation on nutrient supply with respect to urban tree growth and yield. Develop computer models to estimate impairment in plant productivity, regeneration, and related factors that promote ecological unity.	Continue network sampling and prior studies. Integrate prior approaches for studying whole watersheds. Determine ways of ameliorating changes in chemical, physical, and biological characteristics. Develop computer simulation models for identifying long term acidification effects on urban ecosystem productivity. Test remedial actions to reduce detrimental effects on urban forests.	Continue network sampling. Adapt findings to management measures for protecting urban watersheds, reduce acidity impact on soil systems, and on functioning of urban ecosystems.	Understanding of the environmental impacts of acid precipitation on aquatic systems, soils, and functioning of urban ecosystems.
	(4PPY) ($400M)	(6PPY) ($600M)	(6PPY) ($600M)	(8PPY) ($800M)	(8PPY) ($800M)	(32PPY) ($3200M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
2.1.4 Determine how urban trees serve as biological sinks for particulate pollutants.	Define size of particles retained by tree species, density, and composition as modified by climatic factors. Clarify migration routes and movement rates of particulates from atmosphere to deposition sites.	Identify mechanisms of capture of particulates, residence times, and ultimate disposition. Determine possible beneficial, innocuous, or injurious effects on trees.	Develop information on optimum species composition, spacing, and structure to maximize tree potentials for cleansing atmospheric particulates, i.e., radioactive substances, airborne allergens, and agricultural chemicals.	Formulate conceptual and mathematical models to assess significant contributions of tree sinks for particulate pollutants. Begin field studies to find out which tree species are most efficient.	Describe research procedures for inventorying trees as biological sinks at the regional and national planning level.	An understanding of how trees serve as biological sinks for particulate pollutants.
	(3PPY) ($300M)	(3PPY) ($300M)	(3PPY) ($300M)	(3PPY) ($300M)	(3PPY) ($300M)	(15PPY) ($1500M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
2.1.5 Determine role of urban trees as biological sinks for gaseous pollutants.	Establish relation between gaseous removal and tree stress. Quantify significance of amount of gaseous contaminants cleansed by trees. Identify primary absorption and adsorption tree sites.	Identify mechanisms and variations in removal efficiencies as influenced by climatic and edaphic factors. Determine possible beneficial or related effects on trees.	Continue to develop research data. Define optimum species composition, spacing, and stand structure to enhance contributions of urban forests for improving air quality in terms of odors, pesticides, herbicides, and associated aerosol and gaseous pollutants.	Formulate conceptual and mathematical models for assessing importance of tree sinks to gaseous components in ambient environment. Start field work to define optimum species and planting design for reducing gases.	Continue to expand and refine studies. Update findings for regional and national testing.	An understanding of how urban trees serve as biological sinks for gaseous pollutants.
	(3PPY) ($300M)	(3PPY) ($300M)	(3PPY) ($300M)	(3PPY) ($300M)	(3PPY) ($300M)	(15PPY) ($1500M)
Optimizing Program						
2.1.6 Determine impact of heavy metal particulates on nutrient cycling in urban soils.	Inventory heavy metal distribution and concentration in urban roadsides and soils. Delineate occurrence and density of major beneficial soil organisms in field plots.	Establish permanent sampling plots with continuous litter accumulations and quantify litter biomass. Correlate tree productivity and related parameters with specific heavy metals and their density of occurrence.	Continue field and laboratory investigation. Ascertain if tree responses to heavy metals are harmful, beneficial, or inconsequential. Coordinate harmful reactions with nutrient cycling in trees with soil reactions.			An understanding of how heavy metal particulates effect nutrient cycling in urban soils.
	(2PPY) ($200M)	(2PPY) ($200M)	(2PPY) ($200M)			(6PPY) ($600M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
2.1.7 Determine effects of ambient concentrations of air pollutants on cellular processes.	Study reaction of cell membranes and cellular organelles to single and multiple air pollutants under controlled conditions.	Continue short and long term exposures. Investigate: enzymatic changes and metabolic processes; photosynthesis, respiration, transpiration, and related physiological functions; morphological and structural indicators; and biochemical products and physical reactions.	Refine and develop relevant predictive models.		Describe procedures for inventorying and monitoring air pollution damage to trees on regional and national basis.	Methods for determining impact of air pollutants on cellular processes of urban trees.
	(2PPY) ($200M)	(2PPY) ($200M)	(4PPY) ($400M)		(4PPY) ($400M)	(12PPY) ($1200M)
2.2 Understand the basic processes of how urban forests reduce noise and development management guidelines to maximize this benefit.						
Lead Program						
2.2.1 Determine effects of urban forests on sound transmission.	Study effects of urban forest stand configurations on noise reduction potential. Identify differential contributions to noise reduction of different species, arrangements and densities.	Continue FY 1-2 activities and include different meteorological conditions and vegetation types. Identify types of places within urban complex where trees can most effectively be used.	Continue FY 3-4 activities and begin to use scale modeling of vegetative barriers.	Continue modeling activities and use wind tunnels to simulate a variety of atmospheric conditions.	Synthesize information into management guidelines.	Guidelines for planning and designing noise barriers for different locations in the urban complex.
	(4PPY) ($400M)	(4PPY) ($400M)	(3PPY) ($300M)	(1PPY) ($100M)	(1PPY) ($100M)	(13PPY) ($1300M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
2.2.2 Determine interaction of forests, terrain, and urban structures on noise transmission.	Use "artificial" noise sources to compare noise levels on forested and non-forested sites with "identical" topography.	Develop mathematical models of the influence of forested terrain on noise transmission.	Develop scale modeling techniques to predict noise environment contours where forested terrain of varying elevation is present.			Techniques for reducing noise with trees on any terrain configuration.
	(2PPY) ($200M)	(2PPY) ($200M)	(2PPY) ($200M)			(6PPY) ($600M)
2.3 Understand the basic processes of how urban forests moderate climate and develop management guidelines to maximize human comfort and health with urban forests.						
Lead Program						
2.3.1 Determine effect of trees on microclimatic variables by using indices of human thermal comfort.	Throughly review and evaluate literature on indices of human thermal comfort. Using the best index, assess effects of trees on human energy balance in different urban locations through warm climates during various seasons of the year.	Continue FY 1-2 study of tree influence on important climatic variables (solar radiation and air movement) for human energy budgets in warm season.	Devise means for achieving application of information from first four years. Incorporate data from fairly complete studies in Northeast.	Continue activities of FY 7-8 and write design guides based on climatic data base.		Design information showing effects of different species and arrangement of trees in urban areas to maximize human thermal comfort in warm seasons.
	(2PPY) ($200M)	(2PPY) ($200M)	(2PPY) ($200M)	(2PPY) ($200M)		(8PPY) ($800M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
2.3.2 Determine relationships between urban vegetative systems and mesoclimate.	Devise instrumentation to explore wind climates in urban situations.	Use instrumentation developed during FY 1-2 to determine locations in urban areas needing wind protection for pedestrians where trees might be used. Test species for effectiveness with cut trees placed temporarily. Coordinate activities with 2.3.1 so that windbreaks do not reduce windspeeds excessively during warm periods.	Begin planting test windbreaks most desirable in FY 3-4.	Based on tests conducted in FY 5-6, complete tests and define guidelines to use trees to moderate mesoclimate.		Guides to desirable species of trees and desirable windbreak configuration for protection of pedestrians from wind.
	(2PPY) ($200M)	(2PPY) ($200M)	(2PPY) ($200M)	(2PPY) ($200M)		(8PPY) ($800M)
2.3.3 Determine effects of trees and associated vegetation on microclimate through application of human comfort models to climate conditions.	Devise instrumentation to sample air temperature and humidity with level of accuracy necessary to detect variations significant to human comfort.	Sample temperature and humidity in forests of various sizes and predict resulting impact on human thermal comfort.	Continue			Improved knowledge about the effect of urban forest size on temperature and humidity.
	(3PPY) ($300M)	(3PPY) ($300M)	(3PPY) ($300M)			(9PPY) ($900M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
Optimizing Program						
2.3.4 Determine the effect of urban forests on albedo of urban areas, and refine existing estimates of this parameter.	Adapt remote sensing technology to measure albedo using a fine grid system so that the albedo of small groups of trees may be measured. Coordinate with programs in remove sensing.	Use system developed in FY 1-2 to supply information for input to urban mesoclimate models.				Determine effect of distribution of urban trees and forests on overall albedo of urban areas.
	(2PPY) ($200M)	(2PPY) ($200M)				(4PPY) ($400M)
2.4 Understand the basic processes of how urban forests influence home energy consumption and develop management guidelines to maximize this benefit.						
Lead Program						
2.4.1 Using wind tunnel techniques, quantify the effect of windbreaks on reducing infiltration of air into buildings.	Determine the influence of windbreaks (as measured by drag coefficients and before vs. after wind speeds) on air infiltration using a wind tunnel. In addition to windbreak porosity, include width, height, and position relative to the building, and building design as variables.	Correlate airflow data from full scale windbreak tests in 2.4.2 with results of wind tunnel studies. Conduct additional wind tunnel testing if results indicate the need.	Develop wind tunnel techniques for use in landscape design using windbreaks.			Better understanding of the effects of windbreaks on air infiltration.
	(2PPY) ($200M)	(2PPY) ($200M)	(2PPY) ($200M)			(6PPY) ($600M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
2.4.3 Quantify the effects of urban forests on energy consumption in buildings.	Locate residences of identical or similar construction with different degrees of shade and windbreak protection. Because of the large variation in energy consumption caused by lifestyle difference and actual differences in construction of supposedly identical houses, large samples will be required. Records of fuel or electricity use for heating and cooling must be available. Devise procedures to determine by estimation or relatively simple measurements the degree of shade and wind protection. Catalog available residences by structure, degree of shade, wind protection, and type of heating and cooling system.	Collect data on energy use for heating and cooling in relation to building size and construction, assessment of resident lifestyle, climate, degree of shade, wind protection, etc.	Continue FY 3-4 activities. Provide preliminary report.	Continue data collection. Refine relationship and develop preliminary guides to placement of vegetation.	Final data collection and analysis. Prepare report. Refine guidelines.	Guides for using urban forests to minimize energy consumption across a variety of geographical regions.
	(4PPY) ($400M)	(3PPY) ($300M)	(2PPY) ($200M)	(2PPY) ($200M)	(2PPY) ($200M)	(13PPY) ($1300M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
2.4.2 Quantify the effect of tree windbreaks on urban airflow with full-scale field tests.	Determine drag coefficients, and before/after windspeeds to provide measure of windbreak porosity. Include measurements of wind profiles upwind and downwind of windbreaks.	Plant windbreaks for future testing with species, density, and width as variables. Include shrubs and trees. Use information to coordinate with other studies of use of windbreaks for protection of pedestrians. Coordinate with Landscape Quality research results as available.	Continue testing effectiveness of planted windbreaks. Use mobile laboratory in field tests of windbreak reduction on air infiltration and interaction effects between windbreaks and buildings on airflow patterns. Laboratory instrumentation should include pressure sensors on outside surface and automated device to measure actual air infiltration.	Continue FY 5-6 activities.	Continue FY 7-8. Compile information from 2.4.1 and 2.4.2 to provide handbook on windbreak use.	A handbook of windbreak design including composition, density, and position relative to buildings.
	(2PPY) ($200M)	(4PPY) ($400M)	(4PPY) ($400M)	(2PPY) ($200M)	(2PPY) ($200M)	(14PPY) ($1400M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
Safeguard Program						
2.4.4 Quantify the effect of tree shade on energy consumption in buildings.	Measure radiant energy input to exterior of buildings that have different amounts of tree shade. Consider long and shortwave radiation, day and night radiation regimes, and balance similar benefits against probable disadvantages.	Develop models for flow of energy to and from buildings and incorporate FY 1-2 data into models. Different geographic areas (Northeast, Southeast, Northwest, Southwest, etc.) will need to be studied independently but coordinated to avoid duplication of efforts in developing techniques.	Continue model building. Study effect of trees on inducing snow buildup on roofs of buildings and subsequent effect on energy consumption.	Organize results. Make recommendations after coordination with efforts on Landscape Quality, Subtarget 2.9.		Methods to use trees to reduce energy consumption in homes and other small buildings.
	(4PPY) ($400M)	(4PPY) ($400M)	(3PPY) ($300M)	(3PPY) ($300M)		(14PPY) ($1400M)

2.5 Understand the basic processes of how urban forests influence municipal water quantity and quality and develop management guidelines to maximize this benefit.

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
Lead Program						
2.5.1 Determine present and future supply of water from municipal urban forest watersheds.	Inventory and compile available municipal water supply data.	Develop methods to predict future municipal water supply based on other potential water source areas, recycling of wastewater, and vegetation management.	Develop prediction models.	Continue, test prediction models.		Ability to accurately determine present and future supply of water from urban forests (municipal watersheds).
	(3PPY) ($300M)	(3PPY) ($300M)	(3PPY) ($300M)	(3PPY) ($300M)		(12PPY) ($1200M)
2.5.2 Develop and improve methods for managing municipal watersheds to optimize usable water yield.	Evaluate vegetation management alternatives on water quantity; reforestation, timber harvesting, pesticides, species conversion, fertilization, grazing, snow management, defoliants and antitranspirants. Review literature and accumulate sources of quantitative data.	Develop models to predict effects of vegetation management practices on amount and timing of water yields. Define source areas within watersheds where optimum yield increases are possible.	Continue. Update data source. Evaluate constraints due to current aesthetic and cultural values.	Continue.	Develop management guidelines.	Guidelines for managing municipal watersheds for optimum water supply.
	(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)	(20PPY) ($2000M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
2.5.3 Evaluate vegetation management alternatives for maintaining and improving water quality.	Evaluate vegetation management alternatives on water quality; reforestation, timber harvesting, pesticides, species conversion, fertilization, and grazing. Review literature and accumulate sources of quantitative data.	Develop models to predict effects of vegetation management practices on sedimentation, stream temperatures, and nutrient leaching. Conduct field studies to fill in data gaps. Define watershed **source areas** critical to streamflow generation.	Continue. Determine effects on reservoir shoreline and feeder streams in and around urban areas.	Complete field studies.	Develop management guidelines.	Guidelines for managing municipal watersheds for improved water quality.
	(8PPY) ($800M)	(6PPY) ($600M)	(6PPY) ($600M)	(4PPY) ($400M)	(4PPY) ($400M)	(28PPY) ($2800M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
2.5.4 Determine effects of other uses on municipal watersheds as related to water quality.	Evaluate impact of various recreational uses of municipal watersheds on water quality. Review literature and design needed field studies. Include both water-based and land-based activities. Establish parameters to guage impact of land use change on water quality. Investigate methods to handle runoff from streets, parking lots, and structures by using strategically located forested areas as part of the control and purification system for surface runoff.	Continue. Investigate effects of transportation system on water quality municipal watershed access roads, highways, road construction, erosion, and sedimentation, road salts, lead and asbestos problems. Quantify other land use changes.	Continue. Determine effects of grazing on water quality. Monitor land use change parameters.	Develop prediction models.	Develop management guidelines which indicate maximum allowable use levels.	Practical alternatives for integrating various uses on municipal watersheds.
	(8PPY) ($800M)	(8PPY) ($800M)	(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)	(28PPY) ($2800M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
2.6 Investigate the feasibility of using urban forest land for recycling municipal wastewater and sludge, and develop management guidelines to maximize such benefits.						
Lead Program						
2.6.1 Develop models that describe and predict the effects of recycling municipal wastewater and sludge through urban forest ecosystems.	Survey literature on existing information to determine known effects on vegetation, soils, soil moisture litter decomposition, nutrient recycling, micro and macro-organisms, insects and disease, wood fiber quality. Develop a listing of scientists working in these areas and coordinate system for keeping research results current for input into 2.6.2.	Develop and test models for describing ecosystems, disposal system influences, and water systems.	Continue programs.	Continue programs and improve models where needed.	Refine final models.	Increased ability to predict effects of disposal system on forest ecosystems.
	(6PPY) ($600M)	(10PPY) ($1000M)	(10PPY) ($1000M)	(10PPY) ($1000M)	(6PPY) ($600M)	(42PPY) ($4200M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
2.6.2 Determine effects of wastewater and sludge on public health and wildlife.	Obtain and summarize information on population dynamics and health, aerosol transmission of virus and pathogen, pathogen survival in soil or on plants, pathogen effects on people and wildlife, heavy metal and toxic elements, and how they relate to human and wildlife populations. Develop conceptual transmission models.	Model developments. Public health records review.	Model testing.	Develop new methods for evaluating hazards to human health and wildlife.	Refine final models.	Ability to predict effects of disposal systems on public health and wildlife.
	(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)	(20PPY) ($2000M)
2.6.3 Develop new application methods suitable for wastewater and sludge recycling on urban forest lands.	Accumulate and evaluate results of current projects, especially those with long term data bases.	Modify procedures to enhance renovation and application rates. Begin field studies. Test new designs.	Continue.	Continue.	Complete evaluations and develop guidelines.	Procedure for selection of treatment systems over a range of conditions.
	(2PPY) ($200M)	(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)	(2PPY) ($200M)	(16PPY) ($1600M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
2.6.4 Develop guidelines for site selection and management to prevent surface runoff and erosion of treated lands.	Establish range of physical soil characteristics and other site parameters for which land disposal is possible.	Begin field studies where data needs are indicated.	Continue.	Complete field studies.	Complete analysis and design guidelines.	Procedure for selection of suitable sites based on measured parameters.
	(2PPY) ($200M)	(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)	(2PPY) ($200M)	(16PPY) ($1600M)
2.6.5 Develop guidelines for formulating optimal loading and application rates.	Accumulate and evaluate available loading and application rate data.	Begin field studies where data needs are indicated.	Continue.	Complete field studies.	Complete analysis and design guidelines.	Procedure for selection of optimum loading and application rates based on measured parameters.
	(2PPY) ($200M)	(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)	(18PPY) ($1800M)
Optimizing Program						
2.6.6 Determine optimum forest management system to accept and renovate municipal wastewater and sludge.	Evaluate forest type characteristics for suitability.	Evaluate short rotation management systems. Complete field studies.	Continue. Define relationship with forest litter.	Determine effect of stand age on renovation efficiency and tree mortality.	Continue. Develop guidelines.	Increased ability to select forest management systems conducive to waste disposal systems.
	(2PPY) ($200M)	(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)	(2PPY) ($200M)	(16PPY) ($1600M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
2.6.7 Develop and improve methods for reclaiming disturbed lands with municipal wastewater and sludge.	Determine suitable application rates and corresponding suitable vegetation types.	Determine effects of heavy metals on vegetation toxicity.	Determine effects on physical and chemical properties of the spoil.	Determine uptake, recycling, release to groundwater, effects on soil rejuvenation and amelioration of spoil surface temperature.	Determine effects on micro-organism reinvasion and microbial processes. Develop guidelines.	Optimum procedures for reclaiming disturbed lands with application of wastewater and sludge.
	(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)	(20PPY) ($2000M)
Safeguard Program						
2.6.8 Develop new empirical methods of evaluating health hazards connected with recycling wastewater and sludge on urban forest lands.		Evaluate survey data as a means of immediately recognizing potential problem areas.	Design an early warning system.	Evaluate long term projects and test early warning system.	Set up system and develop publications and procedures on monitoring disposal systems.	
		(4PPY) ($400M)	(4PPY) ($400M)	(6PPY) ($600M)	(4PPY) ($400M)	(18PPY) ($1800M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
2.7 Understand the basic processes of how urban forests provide wildlife habitat and develop management guidelines to maximize desirable (and minimize undesirable) wildlife-people interactions.						
Lead Program						
2.7.1 Investigate ways in which urban forests affect distribution and density of urban wildlife.	Determine the habitat relationships of urban wildlife species, both birds and mammals.	Continue. Evaluate the effects of distribution pattern and types of urban open space on urban wildlife species.	Continue. Evaluate plant material to enhance wildlife habitat in urban areas by providing food and shelter.	Continue. Describe urban wildlife population dynamics.	Continue.	Identify the habitat requirements and population dynamics of urban wildlife species.
	(6PPY) ($600M)	(6PPY) ($600M)	(4PPY) ($400M)	(4PPY) ($400M)	(2PPY) ($200M)	(22PPY) ($2200M)
2.7.2 Develop methods for managing urban forest resources to maximize desirable people-wildlife interactions.	Develop management systems to provide desired wildlife species in the various urban environments.	Continue. Determine wildlife preferences for urban residents.	Assess the availability of non-consumptive wildlife recreation opportunities.	Relate needs of wildlife to preferences through management guidelines.		Develop management systems for urban wildlife habitat to produce desired species in population centers.
	(4PPY) ($400M)	(2PPY) ($200M)	(2PPY) ($200M)	(2PPY) ($200M)		(10PPY) ($1000M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
Safeguard Program						
2.7.3 Evaluate the impacts of forest and range (wildlife) management systems on urban nongame wildlife habitats and populations.	Describe the effects of silvicultural practices on nongame bird population, including stand size and distribution, rotation, and type conversion.	Continue. Describe the effects of range management practices, including riparian habitat management on nongame wildlife species.	Continue. Develop guidelines to minimize undesirable consequences of management programs.			Identify the effects of ex-urban forest and range habitat management practices on nongame wildlife resources.
	(4PPY) ($400M)	(6PPY) ($600M)	(6PPY) ($600M)			(16PPY) ($1600M)
Supplementary Program						
2.7.4 Protect and enhance threatened and endangered wildlife (coordinate with Program to Protect and Enhance Threatened and Endangered Species of Wildlife--June 23, 1975).	Assess the potential of urban forests for protecting, or enhancing threatened or endangered wildlife (example--peregrine).	Continue.	Continue.			Assess the role of urban forest vegetation in the protection of threatened and endangered wildlife.
	(2PPY) ($200M)	(2PPY) ($200M)	(2PPY) ($200M)			(6PPY) ($600M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
2.8 Understand how urban forests can be used to improve educational opportunities and develop systems to enhance educational benefits of urban forests.						
Lead Program						
2.8.1 Determine the role that urban forests could play in educational systems.	Assess current status of use of urban forests in educational systems. Develop methodologies and conduct studies on policies relating to use of urban forest areas in education.	Continue. Begin surveys of different organizations supplying urban forest educational opportunities.	Identify barriers to use of urban forest areas in education. Conduct studies on overcoming such barriers.	Conduct surveys of school teachers, and administrators to solicit attitudes toward incorporating urban forest educational opportunities into existing programs.	Integrate urban forest educational opportunities into school curricula.	Methodology for defining environment education policies. Involve school administrators and teachers in design of urban forest environmental education programs.
	(2PPY) ($200M)	(2PPY) ($200M)	(2PPY) ($200M)	(2PPY) ($200M)	(2PPY) ($200M)	(10PPY) ($1000M)
2.8.2 Experiment with alternative modes of educational presentations to determine ways to improve presentation effectiveness.	Identify different types of educational methods used for urban forest environmental education and adapt and devise alternatives; test various methods and alternatives for effectiveness.	Continue.	Continue to test effectiveness of different types of experiences and modes of presentations. Develop tests and methodologies to determine what types of experiences are best conveyed in which mode.	Continue. Develop guidelines using improved methodologies.	Continue.	Effective methodologies for implementing urban forest environmental education and guidelines for applying methods.
	(3PPY) ($300M)	(3PPY) ($300M)	(3PPY) ($300M)	(3PPY) ($300M)	(2PPY) ($200M)	(14PPY) ($1400M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
2.8.3 Find ways to improve the effectiveness of urban forest educational efforts.	Survey literature. Design instruments to test the effectiveness of different types of urban forest educational efforts. Develop survey methodologies for assessing effectiveness.	Continue. Begin pilot testing of instruments and methodologies.	Redesign or create new instruments based on results of pilot studies.	Disseminate improved tests to the field. Set up long term national program for monitoring effectiveness.	Continue. Devise methods for encouraging support and involvement with urban forest environmental education programs.	Improved instruments to test the effectiveness of urban forest educational programs.
	(3PPY) ($300M)	(3PPY) ($300M)	(2PPY) ($200M)	(2PPY) ($200M)	(2PPY) ($200M)	(12PPY) ($1200M)

2.9 Understand how urban forests contribute to the visual quality of urban landscapes and develop management systems that maximize this relationship.

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
Lead Program						
2.9.1 Understand how urban forests contribute to the visual quality of urban landscapes.	Adapt or develop methods to define and measure perceptions and preferences for the visual quality of urban landscapes, including regional species mixes; develop methods for evaluating the contributions of sound, scent, and touch to urban landscape quality.	Complete development of perception and preference methodologies; commence measurement and definition of perceptions and preferences for visual quality. Measure, evaluate, and define how to use sound, scent, and touch to manage urban landscape quality; commence development of methods to relate alternative forest management systems to visual quality; and evaluate the interaction between manmade components and urban forests.	Continue measurement and definition of urban landscape perceptions and preferences, including regional species mixes; continue development of methods for relating alternative management practices; test perceptions and preferences for alternative urban forest configurations (composition, density, spatial arrangement, etc.) designed to enhance urban landscape quality; continue methodologies for interactions of manmade components; evaluate and classify mixes of manmade components and urban forests to define a spectrum of environmental quality.	Complete measurement of perceptions and preferences for urban visual quality; continue testing perceptions and preferences for alternative urban forestconfigurations. Complete evaluation of mixes of manmade components and urban forests in relation to visual quality; develop prediction models for the contribution of visual quality of various configurations of urban forests.	Complete testing perceptions and preferences for alternative urban forest configurations; and complete development of prediction models.	Methodologies for identifying preferences and definitions of preferences for the perceptual quality of urban landscapes, relating alternative urban forest management systems with visual quality; and prediction models for the contributions to visual quality.
	(4PPY) ($400M)	(6PPY) ($600M)	(6PPY) ($600M)	(6PPY) ($600M)	(4PPY) ($400M)	**(26PPY)** ($2600M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
2.9.2 Develop management programs to maximize the contribution of urban forests to the enhancement of regional urban landscape quality.		Identify the contribution of existing forest management practices to the enhancement of urban visual quality.	Complete studies of existing forest management practices; identify visual quality requirements for development or urban forests in various urban situations (parks, visual screens, wind and sound barriers etc.). Develop alternative regional forest management practices to enhance urban visual quality while maintaining ecological integrity.	Develop regional management practices for enhancing the visual quality of disturbed lands in urban areas; and develop guidelines for optimizing visual quality in various urban situations.	Continue.	Enhancement of urban visual quality through application of urban forest management practices to various urban situations on a regional basis and include rehabilitation of disturbed lands.
		(2PPY) ($200M)	(6PPY) ($600M)	(6PPY) ($600M)	(4PPY) ($400M)	(18PPY) ($1800M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
Optimizing Program						
2.9.3 Understand how resource professionals, concerned with developing and managing urban forests, perceive urban forestry and its relationship to the visual quality of urban landscapes.		Measure and define the urban forestry landscape quality perceptions of professional resource managers; contrast the urban forestry-landscape quality perceptions of professionals with those of the public.	Continue. Evaluate and define how the perceptions of professionals contribute to management programs they develop and guide.	Continue. Devise training guides to improve or realign the performance of resource professionals.	Complete research.	Definition of the urban forestry-landscape quality perceptions of resource managers in relation to the user, public, and training guides to improve or realign the management actions.
		(2PPY) ($200M)	(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)	(14PPY) ($1400M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
2.10 Understand how urban forests contribute to outdoor recreation opportunities and experiences, and develop management systems that maximize this relationship.						
Lead Program						
2.10.1 Improve or develop methods to inventory existing and potential supplies of urban forest recreation environments.	Adapt or improve methods to inventory existing and potential urban forest resources for various kinds of recreation; determine relative availability of urban forest recreation resources to various segments of the urban public; identify the environmental impacts of various kinds and intensities of recreational use on regionally different urban forests; define compatability between different kinds of urban forest recreation; determine the meaning to urban people of various kinds of urban forest recreation (link to 1.2).	Complete identification of environmental impacts related to urban forest recreation on a regional basis; develop systems to predict future supplies of urban forest recreation environments; develop methods for assessing the capability of urban forest resources, by regions, to sustain various kinds and intensities of recreational use; complete determination of meaning to urban people of urban recreation (link to 1.2); and determine procedures for maximizing public-private complementarity in supplying urban forest recreation.	Complete prediction systems for future urban forest recreation supplies; continue methodologies for assessing urban forest resource sustained use capabilities.			Methods to assess available and potential supplies of urban forest recreation.
	(6PPY) ($600M)	(6PPY) ($600M)	(6PPY) ($600M)			(18PPY) ($1800M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
2.10.2 Improve or devise methods for managing and maintaining urban forest recreation resources.	Adapt or develop site design principles specific for urban forest recreation; develop methods for providing safe urban forest recreation, including safety in activities and crime prevention (vandalism, littering, etc.); define the relevance of different locations in the urban complex; and adapt or develop methods to maintain or enhance and protect urban forest recreation resources (soils, water, vegetation, and wildlife) on a regional basis.	Complete site design principles; complete and monitor methods for providing recreational safety and continue methodological studies in crime prevention; complete locational relevance studies; continue resource maintenance-enhancement-protection studies; investigate need and means for implementing capacity controls (reservation systems).	Continue methodological studies and prepare guidelines for crime prevention programs; continue resource maintenance-enhancement-protection studies; complete capacity control studies.	Complete methodology and continue resource studies.	Continue resource studies.	Methods for managing and maintaining urban forest recreation resources.
	(8PPY) ($800M)	(8PPY) ($800M)	(8PPY) ($800M)	(6PPY) ($600M)	(4PPY) ($400M)	(34PPY) ($3400M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
2.11 Understand how urban forests and wastewood can be utilized, and develop management systems that maximize utilization.						
Lead Program						
2.11.1 Develop methods to measure the supply of wood and wastewood in urban areas.	Develop methods to inventory the supply of wood and waste-wood in urban areas. Adapt present forest survey methodologies where adaptable. Improve aerial photo interpretation techniques for identifying species and quality of standing trees in urban situations.	Field test methodologies developed in FY 1-2. Continue to improve survey procedures across a range of urban environments.	Continue field tests; refine methodologies where necessary.			A method for surveying the amounts and quality of wood and wastewood in urban areas.
	(4PPY) ($400M)	(4PPY) ($400M)	(3PPY) ($300M)			(11PPY) ($1100M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
2.11.2 Develop methods to decrease the cost of utilizing wood and wastewood in urban areas.	Develop technology, the cost of harvesting, and utilization of trees and wastewood. Study the impacts of cost reductions on city budgets. Explore economic feasibility of various utilization possibilities.	Document effect of utilization programs on urban oriented employment opportunities. Continue to improve technology for mechanical removal and on-site processing of wood and wastewood. Develop marketing strategies for urban wood and conduct small-scale field tests.	Field test, new technologies and market strategies over a wide range of species, and urban environments.	Continue. Make necessary adjustments to reduce cost as a result of findings from field tests.	Continue.	A method for reducing costs of utilizing wood in urban areas.
	(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)	(20PPY) ($2000M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
TARGET 3						
3. Develop methods to breed, select, establish, maintain, and protect urban forest resources at different locations within the urban complex.						
3.1 Define soil, water, and site requirements of forest vegetation throughout the urban complex.						
Lead Program						
3.1.1 Develop methods to identify and improve environmental components critical to the establishment and growth of urban forest vegetation.	Adapt or develop: methods for identifying lands available for establishing urban forests; methods for identifying and delineating existing urban forests; methods for classifying and mapping urban soils; identifying and evaluating microclimatic variations in the regional climate that may be critical to vegetative growth.	Complete methodologies for soil classification and mapping; continue methodologies for site classification and evaluation; adapt or develop methods for evaluating and monitoring the soil water regime and surface water interactions on a regional basis.	Complete climate differences methodologies; continue water studies.	Complete all studies.		Methods for identifying and monitoring environmental components critical to the establishment of urban forests.
	(10PPY) ($1000M)	(10PPY) ($1000M)	(8PPY) ($800M)	(6PPY) ($600M)		(34PPY) ($3400M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
3.1.2 Define the urban soil-plant-atmosphere moisture relationships.	Measure transpiration levels under varying conditions by soil water stress atmospheric demand, stomatal resistance, heat pulse velocity, etc. Use a variety of species common to urban forests in one section of the country.	Continue FY 1-2 activities, refining techniques and expand to other geographical (climatic) regions with more species.	Continue FY 3-4 activities and apply transpiration measuring techniques derived in FY's 1-4 for sample of trees in an urban area to supply inputs on moisture availability for urban energy balance models.	Begin studies of the effect of the arrangement, size and density of urban forests on moisture supply to the urban atmosphere. Combine remote sensing to characterize urban forest distribution patterns and transpiration studies to provide refined input to urban energy balance models.	Combine FY 3-4 and 7-8 techniques and apply to important geographic regions.	Models for predicting the effect of urban forests on urban temperature and humidity.
	(4PPY) ($400M)	(8PPY) ($800M)	(8PPY) ($800M)	(6PPY) ($600M)	(4PPY) ($400M)	(30PPY) ($3000M)
3.1.3 Develop the use of mycorrhizae to increase survival and growth of urban forest species.	Identify mycorrhizal associations on roots of major urban tree species.	Continue. Initiate studies to use known associations to improve tree survival and growth.	Continue studies.	Continue studies.	Complete studies, summarize and develop guidelines.	Guidelines for use of mycorrhizae to improve survival and growth of urban vegetation.
	(3PPY) ($300M)	(6PPY) ($600M)	(6PPY) ($600M)	(6PPY) ($600M)	(6PPY) (600M)	(27PPY) ($2700M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
3.2 Select and develop urban forest vegetation capable of growing at specific locations throughout the urban complex.						
Lead Program						
3.2.1 Develop criteria and strategies for selecting urban forest and associated woody vegetation for planting at specific locations within the urban complex.	Classify species and characteristics according to relative importance in producing specific types of urban forests in major climatic regions. Integrate tree characteristics with site and use requirements, including biological, architectural, managerial, and commercial contexts. Identify species and cultivars that are most promising for urban forests for genetic improvement.	Continue to refine data. Draft selection criteria and strategies. Submit for review by plant specialists, planners, and designers.	Prepare guidelines for selecting vegetation for urban uses, and for identifying needed genetic improvements.	Monitor utility of guidelines among practitioners (Link to Subtarget 4.5).	Revise guidelines according to latest research results (Link to all pertinent subtargets).	Guidelines for selecting urban forest vegetation and for genetic improvement.
	(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)	(2PPY) ($200M)	(2PPY) ($200M)	(16PPY) ($1600M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
3.2.2 Develop improved varieties of urban forest vegetation adapted to four regions of the U.S., and to specific uses and sites within each region.	Design and initiate breeding programs for 16-20 species, and expand existing programs. Specify improvement goals, strategies, and selection criteria. Begin provenance experiments and selection projects; collect seeds, scions, and prepare rootstocks.	Continue provenance experiments and selection of superior phenotypes. Grow seedlings, propagate selected plants, establish plantations, clonal tests, and breeding arboreta. Develop or adapt propagation methods and controls for diseases and insects.	Continue selection and propagation. Care for plantations and breeding arboreta. Evaluate growth, health, and other desirable traits. Develop or adapt methods for pollen collection and artificial breeding.	Continue care of plantations, measure and evaluate them, select superior genotypes. Begin artificial mating, collect fruit, extract and store seed. Begin progeny tests.	Continue care of plantations, evaluation, selection, breeding, progeny testing. Establish seed orchards and clone orchards for mass-producing improved varieties.	Improved varieties of urban forest vegetation; technology for propagation and artificial mating; information for designing continued breeding programs.
	(8PPY) ($800M)	(8PPY) ($800M)	(12PPY) ($1200M)	(16PPY) ($1600M)	(16PPY) ($1600M)	(60PPY) ($6000M)
3.2.3 Test and monitor performance of cultivars and improved varieties under conditions of urban stresses. (Link to Subtarget 4.5).	Initiate cooperative performance test program in northeastern U.S. Coordinate and design system of test plantings, establishment and measurement.	Expand test program and adapt to species and conditions of southern and western U.S. Continue coordination.	Continue test program. Analyze and interpret results.	Continue test program. Analyze and interpret results.	Continue test program. Analyze and interpret results, prepare regional summaries, and report to cooperators.	Performance comparisons of cultivars and varieties to guide planting choices, and improve care and protection practices. A cooperative organization for monitoring progress.
	(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)	(20PPY) ($2000M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
Optimizing Program						
3.2.4 Determine intraspecific patterns of genetic variation in useful traits among individuals, populations, and varieties of important urban forest species (Link with 3.2.2).	Initiate regional studies of genetic variation in natural and artificial populations.	Continue studies, make physical and chemical analyses of seedlings related to site requirements, resistance to adverse agents, and other constraints.	Continue.	Continue. Correlate traits with age and environmental variables.	Summarize and interpret results. Identify opportunities to improve genetic selection techniques.	Better knowledge about genetic variation and how to exploit it; improved selection techniques.
	(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)	(20PPY) ($2000M)
3.2.5 Compare effectiveness of different breeding strategies for achieving genetic gains in important urban forest species and traits (Link with 3.2.2).	Superimpose experiments on selection and breeding programs, designed to estimate parameters which predict genetic gain.	Mate selected trees to produce intra- and inter-racial and species hybrids.	Grow seedlings and establish experimental plantings.	Continue care of trees, measure, and analyze results.	Continue measurements and analyses. Interpret results and design breeding strategies.	Better knowledge about relative effectiveness of breeding strategies.
	(2PPY) ($200M)	(2PPY) ($200M)	(2PPY) ($200M)	(2PPY) ($200M)	(2PPY) ($200M)	(10PPY) ($1000M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
Safeguard Program						
3.2.6 Evaluate opportunities for obtaining improved varieties by introducing species and cultivars from other countries.	Identify most promising species and cultivars, consulting with domestic and foreign tree specialists. Prepare test sites, arrange quarantine.	Establish plantings, inspect for diseases and insects. Measure trees, characterize sites.	Measure and care for trees. Observe condition, identify injurious agents.	Continue.	Continue. Summarize and interpret results. Identify most promising species and cultivars, provide propagules to nurseries.	Improved varieties of urban forest vegetation to diversify available stock. Better understanding of adaptability of introduced trees to American urban environments.
	(2PPY) ($200M)	(2PPY) ($200M)	(2PPY) ($200M)	(2PPY) ($200M)	(2PPY) ($200M)	(10PPY) ($1000M)
3.3 Establish and manage urban forest vegetation capable of growing at specific locations throughout the urban complex.						
Lead Program						
3.3.1 Develop methods to establish urban forests for specific purposes at specific locations.	Adapt or develop methods for planting site preparation; methods for distributing and handling stock; planting procedures including direct seeding.	Continue.	Continue.			Improved methods for site preparation, distribution and handling of stock, and planting and seeding procedures.
	(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)		(12PPY) ($1200M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
3.3.2 Develop methods to manage urban forests.	Adapt or develop a complete range of cultural practices, including the following: cultivation, irrigation, drainage systems, staking and support, pruning and thinning, fertilization and mulching and structural repair (of wounds or decay excavations).	Continue. Develop methods to evaluate the influences of urban stress; evaluate costs associated with plant establishment, maintenance, and protection.	Continue. Determine causes, nature, and impact of major wounds in major hosts.	Continue by completing cost studies. Develop procedures for reducing accidental wounds in urban trees.	Continue.	Improved cultural practices for managing urban forest vegetation, estimates of costs for establishing and managing urban forests, and methods for evaluating vegetation under urban stresses.
	(6PPY) ($600M)	(6PPY) ($600M)	(6PPY) ($600M)	(6PPY) ($600M)	(3PPY) ($300M)	(27PPY) ($2700M)
Optimizing Program						
3.3.3 Adapt or develop methods for maximizing natural reproduction of urban forests.	Evaluate the applicability of traditional silviculture to urban forests.	Continue and devise alternative approaches where natural regeneration is ineffective.	Continue.	Continue.		Improved methods for establishing urban forests by natural reproduction.
	(2PPY) ($200M)	(2PPY) ($200M)	(2PPY) ($200M)	(2PPY) ($200M)		(8PPY) ($800M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
3.4 Develop control systems for major insect and disease problems in urban forest management programs.						
Lead Program						
3.4.1 Determine control opportunities for problems caused by insect and disease interactions.	Review and analyze existing information and procedures that identify and evaluate the impact of major regional insect and disease problems of urban forests. Conduct regional surveys to determine impacts of insect and diseases of urban forests. Clarify insect-disease relationships. Develop techniques for sampling and estimating densities of both insects and disease agents.	Continue studies on insect-disease relationships. Improve or develop controls for preventing or ameliorating the effects of the insect, the disease agent, or both.	Continue study of these complexes with emphasis upon further interactions with other organisms. Continue evaluation of controls and begin integration of control concepts with computer simulation models for pest management.	Continue development of control strategies and simulate management activities via the computer simulation models of major problems in representative urban complexes. Prepare general environment impact information and obtain registration for new management procedures.	Integrate control strategies into pest management systems.	Improved understanding of the major insect-disease associations in urban forests leading to development of efficient control systems.
	(8PPY) ($800M)	(8PPY) ($800M)	(8PPY) ($800M)	(5PPY) ($500M)	(3PPY) ($300M)	(32PPY) ($3200M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
3.4.2 Determine methods to reduce impacts of major infectious diseases in urban forests.	Study life cycles of pathogens and environmental factors influencing disease development or host susceptibility. Include studies of nursery, outplanted, and natural vegetation.	Continue studies. Initiate identification of cultivars or species that appear to exhibit field resistance to major diseases.	Continue studies and test methods of control suggested by results obtained in FY-4. Test systems to treat wounds.	Continue studies. Evaluate possibilities of increasing genetic resistance to major diseases and identify for future study elsewhere.	Conclude studies and draft recommendations, including methods to treat wounds.	Improved understanding of underlying processes and factors contributing to major infectious diseases of urban trees and recommendations for their control.
	(6PPY) ($600M)	(6PPY) ($600M)	(6PPY) ($600M)	(6PPY) ($600M)	(6PPY) ($600M)	(30PPY) ($3000M)
3.4.3 Determine methods to reduce urban tree stresses and prevent consequent dieback, declines and physiogenic disorders.	Identify the major declines and physiogenic disorders in different use-location categories. Relate to probable initiating abiotic-biotic urban stress factors.	Initiate studies to determine (1) the most important urban abiotic-biotic stress factors involved in key problems identified in FY 1-2; and (2) the associated organisms of secondary action (insects, nematodes, pathogens). Begin studies to alleviate effects of stress factors.	Continue studies. Initiate studies on primary host-stress interactions and on organism requirements.	Continue studies.	Conclude studies. Summarize results and outline recommendations.	Recommendations for reducing or preventing dieback-declines or physiogenic disorders in existing urban forests.
	(4PPY) ($400M)	(8PPY) ($800M)	(8PPY) ($800M)	(8PPY) ($800M)	(6PPY) ($600M)	(34PPY) ($3400M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
3.4.4 Develop cultural and chemical methods to reduce impacts of major insect pests.	Determine role, mode of action, and factors influencing the impact of the major urban forest insect pests. Identify opportunities to adapt existing or developing new methods to reduce impacts of insects on urban trees. Survey for host deterrency or resistence to attack by major insect forms through observations of field infestations.	Conduct tests of new or adapted insect control methods, evaluate results and devise methods of integrating insect and disease control strategies. Continue host resistence evaluation and proceed with genetic selection from observed resistant germ plasm.	On basis of FY 3-4 evaluations continue control methods tests on pilot scale. Integrate chemical and cultural control methods with existing natural control factors and biological control methods under development	Simulate insect-disease management actions and validate results through field evaluation. Modify pest management model as appropriate.	Complete integration of chemical, silvicultural and biological control into the pest management systems.	Efficient cultural and chemical control procedures for preventing or ameliorating major urban forest pests.
	(5PPY) ($500M)	(10PPY) ($1000M)	(10PPY) ($1000M)	(4PPY) ($400M)	(2PPY) ($200M)	(31PPY) ($3100M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
3.4.5 Develop biological controls to reduce impacts of major insect pests.	Survey through field collections the current biological control species and evaluate their effectiveness upon major urban pests and potential alternate hosts. Identify potential conflicts with chemical and cultural control methods. Ascertain the desirability of introducing exotic species for introduction into the U.S.	Continue to assess the importance of the more effective biological control organisms and collect data for a simulation model of pest management. Arrange for the collection and quarantine clearance of additional exotic biological control agents for introduction into the U.S. Assess the need for and type of chemical or silvicultural controls which can be optimally integrated with principal biological control organisms.	Evaluate exotic and native bio-control agents and integrate with chemical or silvicultural controls. Establish acceptable damage thresholds in relation to different bio-control agents.	Extend introductions and manipulations of the most effective biological control organisms to other locations. Continue to assess biological controls and their integration with other control means. Update simulation model. Sample additional urban forest regions characterize the bio-control approach and with the aid of the simulation model initiate management activities.	Complete integration of select bio-controls with preferred chemical or silvicultural controls.	Efficient biological controls for preventing or ameliorating major urban forest pests.
	(6PPY) ($600M)	(6PPY) ($600M)	(6PPY) ($600M)	(5PPY) ($500M)	(4PPY) ($400M)	(27PPY) ($2700M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
Optimizing Program						
3.4.6 Develop regional pest management models for major urban forest insects and diseases.		Construct preliminary regional models to clarify the relationship between insects and diseases and beneficial components of the major urban forest ecosystems. Update the model with pertinent data from information obtained in previous sections.	Continue to evaluate and assess the major components of the urban forest ecosystem. Simulate urban forest pest interactions through computer models and assess the need for applying controls. Validate simulations through field observations; refine and update model.	Predict urban forest pest interactions and the need for and type of management action in different geographic locations by using simulations. Refine and update model with biological and climatological data.	Extend and coordinate the prediction for pest management action over broad geographic regions. Develop regional pest-management approaches and employ effective environmentally compatible action.	Management options for anticipating and resolving pest problems and methods for reducing unnecessary pesticide application.
		(7PPY) ($700M)	(7PPY) ($700M)	(7PPY) ($700M)	(5PPY) ($500M)	(26PPY) ($2600M)
3.4.7 Determine methods to measure stress-induced reductions in host vigor.	Evaluate existing potential tools including bioelectronics, starch reserves, etc. Explore other possible means of assessing vigor of urban vegetation affected by stress factors.	Continue studies; and initiate studies using vigor assessments as predictors of trees ability to tolerate further stress, or to resist invasion of secondary organisms.	Continue studies.	Conclude studies and prepare packages for techniques		Techniques to assess response of major urban tree hosts to major stresses.
	(2PPY) ($200M)	(2PPY) ($200M)	(2PPY) ($200M)	(2PPY) ($200M)		(8PPY) ($800M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
3.4.8 Determine the role of environmental and climatological parameters influencing development, survival and behavior of major insects and diseases.	Evaluate and select weather monitoring systems for measuring environmental factors influencing insects and disease development. Gather and evaluate records of past insect and disease interactions with weather conditions.	Establish monitoring stations in selected urban forest use-locations. Correlate weather data with insect-disease occurrence and severity. Update historical information.	Continue previous studies. Initiate development of environment-insect-disease zones of impact severity.	Continue previous studies. Test predictive model through simulations; sample to validate accuracy of model.	Integrate climatological model into pest management system.	Improved ability to predict insect and disease impacts determined by unique urban climatological conditions.
	(7PPY) ($700M)	(7PPY) ($700M)	(7PPY) ($700M)	(7PPY) ($700M)	(3PPY) ($300M)	(31PPY) ($3100M)
Supplementary Program						
3.4.9 Determine the effects of environmental pollutants on major pest insects.		Assess under laboratory conditions the effect of common urban pollutants upon the most important urban forest pests and their natural enemies	Continue assessment begun in FY 3-4 and attempt to establish tolerance limits to pollutants by key-bio-control agents and insect pests.	Pattern bio-control release to urban forest regions based upon tolerable pollution levels. Assess effects of field releases upon major phytophagous pests.	If FY 7-8 results so dictate, continue patterned releases and evaluations. Simulate with the model and validate findings through field evaluation.	Procedures for selecting the most meaningful urban forest pest control strategy based upon existing pollution conditions.
		(3PPY) ($300M)	(3PPY) ($300M)	(3PPY) ($300M)	(2PPY) ($200M)	(11PPY) ($1100M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
3.5 Develop methods to protect urban forests from detrimental impacts of fire, animals, and man's activities.						
Lead Program						
3.5.1 Determine nature and extent of wildfire problems at the urban-rural forest interface and develop appropriate prevention programs.	Analyze causes of urban forest wildfires.	Complete incidence evaluation, and develop prevention methods.	Complete prevention program and involve affected public in fire reduction programs.	Complete development of prevention program.		Improved understanding of the wildfire problem in urban forests and programs to prevent such fires.
	(2PPY) ($200M)	(2PPY) ($200M)	(2PPY) ($200M)	(2PPY) ($200M)		(8PPY) ($800M)
3.5.2 Adapt existing wildland fuel management alternatives and, where necessary, develop new fuel management techniques for urban forests.	Evaluate effectiveness and costs of alternative urban forest fuel modification methods.	Continue effectiveness-cost evaluations for different urban forest conditions and develop fuel management measures that minimize aesthetic impacts.	Complete.			Methods to manage fire fuel levels for different urban forest conditions.
	(2PPY) ($200M)	(2PPY) ($200M)	(2PPY) ($200M)			(6PPY) ($600M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Yea.
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
3.5.3 Develop firefighting equipment, techniques, and organization systems for use on large destructive fires at the urban-rural interface.	Evaluate existing wildland firefighting equipment and techniques for application to urban forest conditions.	Develop new equipment and techniques as needed. Study alternative organizational structures for fire control systems.	Continue control studies and strategies.	Complete control studies and setup administrative structures to test control strategies.	Complete control strategy tests and prepare organizational guides.	Improved multi-agency coordination, firefighting methods, and equipment to control urban forest wildfires.
	(2PPY) ($200M)	(2PPY) ($200M)	(2PPY) ($200M)	(2PPY) ($200M)	(2PPY) ($200M)	(10PPY) ($1000M)
3.5.4 Develop methods to protect urban forests vegetation from the detrimental influences of animals and man's activities.	Evaluate types of damage to urban forest vegetation and the environment as a consequence of the activities of man and animals. Classify damage by cause.	Complete evaluations and develop methods for correcting and preventing damage.	Continue.			Methods for correcting and preventing man and animal caused damage.
	(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)			(12PPY) ($1200M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
3.6 Develop an assessment and inventory system to monitor information necessary to carry out long term urban forest management programs.						
Lead Program						
3.6.1 Develop, test, and establish an urban forestry management data monitoring system.	Define management information needed in devising management programs in preceeding subtargets. Condense into management inventory data system.	Search existing methods for monitoring data needs. Devise new indices where necessary.	Search existing technology for methods to monitor full spectrum of data needs for full scale urban forest management system.	Adapt existing technology to data needs. Devise new technology where needed.	Continue. Adapt monitoring system to new data needs as management guides are developed in relation to other Subtargets. Implement the system.	A system to monitor and inventory data needed to operate a full scale urban forestry management program.
	(2PPY) ($200M)	(2PPY) (200M)	(2PPY) ($200M)	(4PPY) ($400M)	(4PPY) ($400M)	(14PPY) ($1400M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
TARGET 4						
4. Develop strategies to integrate sound urban forestry planning and management into the urban planning and development process.						
4.1 Evaluate the impact of factors related to the urban development process on the ability of urban forests to deliver benefits.						
Lead Program						
4.1.1 Identify influence of social, economic, and cultural factors on the ability of urban forests to deliver benefits.			Trace urban development as a function of various social, economic, and cultural characteristics and attitudes toward land development of metropolitan populations. Relate these characteristics to variations in distribution of urban forest and related resources. (4PPY) ($400M)	Identify trends in social and cultural attitudes, urban development philosophies, and determine how these attributes are likely to influence urban forest resource systems in the future. (4PPY) ($400M)	Develop methods to encourage desirable urban forest patterns that are consistent with changing sociocultural factors and attitudes toward land. (4PPY) ($400M)	Information for making realistic decisions on management alternatives concerned with urban development programs. (12PPY) ($1200M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
4.1.2 Determine impact of Federal, State, and local government development policies and judicial systems on the ability of urban forests to deliver benefits.		Define system of Federal, State, local planning, and development, including environmental regulations that impact the ability of urban forests to deliver benefits. Catalogue existing legislation, court decisions, etc. that affect urban forest management systems.	Evaluate past and potential effects of public infrastructure on urban forest management system.	Determine ways in which governmental policies could be altered or adapted to enhance potential of urban forests to deliver benefits.	Define boundaries of urban forest policy and management imposed by such policies. Develop procedures for implementing urban forest management programs within constraints imposed by existing and projected legal infrastructure.	Develop information on ways in which governmental and legal infrastructure influence urban forest management and develop alternative policies.
		(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)	(16PPY) ($1600M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
4.1.3 Determine past and potential impact of changing demands for urban services (transportation, housing, utilities, etc.) on the ability of urban forests to deliver benefits.			For a spectrum of metropolitan areas, trace change in urban service systems in relation to development of urban forest resource pattern. Include studies of major land use changes. Identify service technologies that most severely impact on urban forest resources.	Determine degrees of compatability and trade off relationships and needs for urban forest management. Project changing demands for urban services and transform into predicted impacts on urban forest management.	Develop urban forest management systems that are most compatible with changing demands for urban services.	Organization of a management system that maximizes contribution of urban forest benefits within constraints imposed by changing demands for urban services.
			(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)	(12PPY) ($1200M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
4.2 Develop and test land use control methods that maximize the ability of urban forests to deliver benefits.						
Lead Program						
4.2.1 Design land use control systems and policies that maintain and protect urban forest and related resources, as well as protect man's developments.	Measure impact of urban land use systems and development patterns on components of the urban forest--soil, water, air, etc. Determine impacts on human health and safety, including impact of landslides, flood, fire, insects and disease. Focus on state enabling legislation that may be needed or useful in establishing urban forestry programs.	Identify and assess the influence of past land use regulation mechanisms such as agricultural districts, landbanks, zoning, forest practice regulations, Eminent Domain (taking), taxation, incentive systems, and environmental regulation on urban forest establishment, management, and protection policies and practices.	Continue FY 3-4 activities and develop guidelines to improve effectiveness of zoning, housing codes, etc. as means of reducing destructive effects of wildfires.	Develop new land use regulation systems that maximize ability of urban forests to produce for needed urban services, health, and safety, and to minimize the risk of loss due to wildfires.	Develop equitable methods to implement new land use control systems.	Understand how past and current urban land development patterns have influenced components of the urban forest. Identification of effective land use regulations, integration of existing regulations, and development of new regulations to maintain and protect urban forests and related resources.
	(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)	(6PPY) ($600M)	(6PPY) ($600M)	(24PPY) ($2400M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
4.3 Develop administrative systems to organize and implement urban forest management programs and policies.						
Lead Program						
4.3.1 Define systems for administering urban forestry management programs.	Define data and information needs of the urban forestry administrative system; develop computerized system for manipulating data on components of urban forests (trees, etc.), management schedules, cultural applications, and other regular administrative services essential for a city/county to operate an urban forest system.	Complete data and information collection. Continue study of urban decision-making structure to determine how urban forest administration can best complement the system.	Continue program and complete evaluation of personnel needs.	Develop methods to integrate urban forestry program administration with policymaking authority; and identify personnel requirements.	Complete all activities.	An operational system for administering urban forestry management including; defining data needs, a computer system, integration of urban forest management with policymaking authority, and definition of personnel requirements.
	(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)	(2PPY) ($200M)	(18PPY) ($1800M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
4.4 Determine influence of technological and social change on the ability of urban forests to provide continuing benefits.						
Lead Program						
4.4.1 Monitor technological and social changes that are likely to influence urban forest delivery systems.		Identify indices of technological and social change that have influenced urban forest resource systems in the past. Monitor and project these indicators for their likely influence on future urban forestry delivery systems.	Develop technology and social change prediction models; monitor present technology and social activity; continue efforts in FY 1-2.	Continue monitoring activities.	Integrate as function of urban forestry administrative management system.	Identify and predict trends in technology and social action that influence urban forest delivery systems.
		(2PPY) ($200M)	(3PPY) ($300M)	(3PPY) ($300M)	(2PPY) ($200M)	(10PPY) ($1000M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
4.5 Develop and test programs for disseminating sound urban forest management information and stimulating involvement in the urban forestry planning and decisionmaking system.						
Lead Program						
4.5.1 Develop information and education programs for various factors involved in the urban forest planning system.	Identify and describe information needs of various factors--both public and professional, i.e., school children, adult public, private land development interests, legislative and other land use decision makers, urban resource managers, etc. (Link to Subtarget 1.2).	Identify and describe cultural beliefs, customs, and attitudes which interact with (either contributive or counterproductive to) obtaining optimum utility from urban forest resources. (Link to 1.2). Evaluate the feasibility for altering or enhancing (through education) the behavior resulting from customs and beliefs, which negatively or positively influences the productivity of urban forests.	Evaluate techniques for assessing impacts of educational programs. Establish criteria for measuring information transfer. Begin monitoring information needs.	Continue monitoring activities. Begin description of both the positive and negative consequences of existing beliefs, customs and levels of knowledge and identify counter productive progressional resource management and development practices. Determine information needs and methods for reaching appropriate audience.		Identification of lay and professional customs, beliefs and practices on which urban forestry educational programs should be based. A long term monitoring of changing information needs leading to a more responsive urban forestry decision system.
	(3PPY) ($300M)	(3PPY) ($300M)	(3PPY) ($300M)	(3PPY) ($300M)		(12PPY) ($1200M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
4.5.2 Develop theory and methods for involving urban residents in the urban forestry planning and management decisionmaking process.	Utilizing socio-psychological relationships found between people and urban vegetation (Subtarget 1.2). Determine degree of interest in urban forestry and develop information programs that activate these relationships. Synthesize and evaluate existing education techniques for various public groups, including children, and design and test new techniques as needed. Develop methods for gaining positive involvement and commitment.	Continue FY 1-2 activity and begin evaluation of alternative mass media information dissemination systems.	Continue evaluation of mass media and public involvement systems and pilot test methods to involve school-aged and adult publics in urban forest projects.	Develop prototype school-based, mass media, and other programs based on knowledge from urban forestry research (Program 4.5.1).	Devise a strategy for continuous updating of dissemination programs and for expanding public exposure to such programs.	A comprehensive system for disseminating urban forest research information to the general public and an effective means of getting urban people involved in urban forestry planning.
	(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)	(20PPY) ($2000M)

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
4.5.3 Design and conduct workshops, symposia, and other methods for informing urban land use decision makers about urban forest benefits and sound management practices, and for informing urban forest managers about effective techniques for securing public involvement.			Test the effectiveness of alternative information technology transfer systems (including workshops, bulletins, tours, etc.) for effectiveness in communicating with both public and private decision makers. Build and test similar programs to help urban forest managers secure effective public involvement.	Develop specific dissemination programs and provide channels for continuing researcher-decision maker-manager communication. Clearly define the objectives of the dissemination programs.	Continue FY 7-8 activities. Hold symposia, conferences, etc. as appropriate.	A system and method to continually inform professionals and urban forest decision makers about urban forest management technology.
			(4PPY) ($400M)	(4PPY) ($400M)	(4PPY) ($400M)	(12PPY) ($1200M)

4.6 Conduct tests of alternative methods to integrate urban forestry into the urban planning and development process.

URBAN FORESTRY RESEARCH PROGRAM SCHEDULE

(PPY) - Professional Person Year
($M) - Cost

Program	FY 1-2	FY 3-4	FY 5-6	FY 7-8	FY 9-10	EXPECTED ACCOMPLISHMENTS AND COSTS TOTAL PPY & $M
Lead Program						
4.6.1 Conduct short term pilot tests of urban forestry management programs in urban areas where success is potentially high.	Identify areas which have urban forests implement a full scale urban forestry program, and willingness to cooperate for selected areas. Plan pilot studies to establish an urban forestry program integrated with other urban programs, and commence planning for the pilot study.	Complete planning and implement on a regional basis at least three pilot tests. Establish criteria for monitoring costs and program accomplishment.	Continue pilot studies and monitor results.	Evaluate pilot programs. Adjust as needed by monitoring system. Evaluate effectiveness and needs of the program.	Based on experience from pilot tests, recommend program revisions for further application and implementation. Continue monitoring public and management response to program.	Urban forestry pilot studies will demonstrate how urban forestry management can be integrated with other urban programs and planning functions. Experience will be available for general application.
	(2PPY) ($200M)	(4PPY) ($400M)	(4PPY) ($400M)	(3PPY) ($300M)	(3PPY) ($300M)	(16PPY) ($1600M)
4.6.2 Establish long-term tests of urban forest management to monitor the long-term effects on environmental elements and human benefits.			Using previously selected pilot study areas (Program 4.6.1), develop methods for monitoring the long term effects of urban forest management on environmental elements and human benefits.	Continue activities and devise means for correcting problems that develop as urban forestry management continues and is integrated with other urban planning programs.	Continue and integrate with urban planning process and urban needs. Monitor long term urban system for potential effects on urban forest management.	Definition of long term effects of urban forest management and other urban programs on environmental elements and benefits. Provide feedback systems to correct emerging problems.
			(3PPY) ($300M)	(3PPY) ($300M)	(3PPY) ($300M)	(9PPY) ($900M)

TARGET 1 - ASSESS THE HUMAN BENEFITS FROM URBAN FORESTS

	Priority[1]	Cost $M[2]	Regional Emphasis[3]
1.1 SOCIAL WELL-BEING UNDER VARYING URBAN FOREST CONDITIONS	1		7
Lead Program			
1.1.1 Compare relative social well-being due to urban forest conditions		800	
Optimizing Program			
1.1.2 Evaluate environmental maintenance		500	
1.2 SOCIAL-PHYSIOLOGICAL INTERACTIONS--URBAN PEOPLE AND URBAN FORESTS	2		7
Lead Program			
1.2.1 Human response to urban forests		1400	
1.2.2 Measure benefits		1600	
1.2.3 Divergent public concerns		1400	

1/ Priority for research programs by subtarget code:

1 = Essential
2 = Very Important
3 = Important

2/ Cost summarized for all program activities by subtarget

3/ Region where research program outlined for subtarget should be stressed.

Regional Code: 1 = Northeast
2 = Southeast
3 = Midwest
4 = Southwest
5 = West Coast
6 = Rocky Mountains
7 = Nonregional
8 = All Regions

		Priority[1]	Cost $M[2]	Regional Emphasis[3]
1.3	BENEFITS FROM POLLUTION REDUCTION	2		7
	Lead Program			
	1.3.1 Physical health benefits		800	
	1.3.2 Losses due to air pollution and future demand		800	
1.4	BENEFITS FROM AESTHETIC ENHANCEMENT AND RECREATION	1		7
	Lead Program			
	1.4.1 Measure demand and benefits--aesthetics and recreation		2000	
	Optimizing Program			
	1.4.2 Projected demand--aesthetics and recreation		600	
1.5	BENEFITS FROM CLIMATE CONTROL AND ENERGY CONSERVATION	2		7
	Lead Program			
	1.5.1 Quantify energy savings		1200	
	Safeguard Program			
	1.5.2 Demand and benefits from climate moderation		800	
1.6	BENEFITS FROM URBAN FOREST EDUCATION	3		7
	Lead Program			
	1.6.1 Assess urban forest education values		1000	
	1.6.2 Assess recreation values from education		400	

		Priority[1]	Cost $M[2]	Regional Emphasis[3]
1.7	BENEFITS FROM WOOD AND WATER PRODUCTION	3		7
	Lead Program			
	1.7.1 Demand for urban grown wood		400	
	1.7.2 Demand for municipal water supply		600	
	1.7.3 Value of urban forest watersheds		1100	
	Optimizing Program			
	1.7.4 Amenity values from urban water supply		400	
	TOTAL TARGET 1----------		$15,800,000	

TARGET 2 - UNDERSTAND THE BASIC PROCESSES THROUGH WHICH URBAN FORESTS INFLUENCE THE URBAN ENVIRONMENT AND PRESCRIBE MANAGEMENT GUIDES TO IMPROVE THE QUALITY OF URBAN ENVIRONMENTS

		Priority[1]	Cost $M[2]	Regional Emphasis[3]
2.1	INFLUENCE ON AIR QUALITY	2		1,5,6
	Lead Program			
	2.1.1 Effect of existing pollutants		1800	
	2.1.2 Wet and dry precipitation/urban ecosystems		1800	
	2.1.3 Acid precipitation/urban ecosystems		3200	
	2.1.4 Biological sinks/particulate pollutants		1500	
	2.1.5 Biological sinks/gaseous pollutants		1500	
	Optimizing Program			
	2.1.6 Heavy metals particulates/nutrient cycling		600	
	2.1.7 Air pollutants/cellular process		1200	
2.2	NOISE REDUCTION	2		7
	Lead Program			
	2.2.1 Urban forests/noise transmission		1300	
	2.2.2 Interaction of forests, terrain, and structures on noise		600	

		Priority[1]	Cost $M[2]	Regional Emphasis[3]
2.3	CLIMATE MODERATION	2		1,2,4,5
	Lead Program			
	2.3.1 Trees/microclimate		800	
	2.3.2 Trees/mesoclimate		800	
	2.3.3 Trees/human comfort		900	
	Optimizing Program			
	2.3.4 Trees/albedo of urban areas		400	
2.4	ENERGY CONSERVATION	1		1,2,4,5
	Lead Program			
	2.4.1 Laboratory windbreak tests		600	
	2.4.2 Field windbreak tests		1400	
	2.4.3 Urban forests/energy consumption		1300	
	Safeguard Program			
	2.4.4 Shade/energy consumption		1400	

		Priority[1]	Cost $M[2]	Regional Emphasis[3]
2.5	WATER/QUALITY AND QUANTITY PRODUCTION	1		1,4,6
	Lead Program			
	2.5.1 Municipal watersheds/supply analysis		1200	
	2.5.2 Municipal watersheds/water yield		2000	
	2.5.3 Municipal watersheds/water quality		2800	
	2.5.4 Municipal watersheds/multiple use		2800	
2.6	MUNICIPAL WASTEWATER AND SLUDGE	2		1,3
	Lead Program			
	2.6.1 Prediction/effects of recycling wastewater		4200	
	2.6.2 Wastewater/people and wildlife		2000	
	2.6.3 New application methods		1600	
	2.6.4 Site selection for management		1600	
	2.6.5 Optimal application rates		1800	
	Optimizing Program			
	2.6.6 Forest management systems		1600	
	2.6.7 Reclaiming disturbed lands		2000	
	Safeguard Program			
	2.6.8 Health hazards from wastewater recycling		1800	

		Priority[1]	Cost $M[2]	Regional Emphasis[3]
2.7	KNOWLEDGE AND MANAGEMENT FOR URBAN WILDLIFE	2		8
	Lead Program			
	2.7.1 Ways urban forests affect wildlife		2200	
	2.7.2 Methods for managing for wildlife		1000	
	Safeguard Program			
	2.7.3 Impacts of management systems on wildlife		1600	
	2.7.4 Management for threatened and endangered species		600	
2.8	EDUCATIONAL OPPORTUNITIES	2		7
	Lead Program			
	2.8.1 Role of urban forests in education		1000	
	2.8.2 Educational presentations		1400	
	2.8.3 Educational program improvements		1200	

		Priority[1]	Cost $M[2]	Regional Emphasis[3]
2.9	KNOWLEDGE AND MANAGEMENT FOR LANDSCAPE QUALITY	2		1,4,5
	Lead Program			
	2.9.1 Contribution to landscape quality		2600	
	2.9.2 Management for enhancing regional landscapes		1800	
	Optimizing Program			
	2.9.3 Resource professionals relation to landscape quality		1400	
2.10	MANAGEMENT FOR OUTDOOR RECREATION	1		8
	Lead Program			
	2.10.1 Methods to assess recreation supplies		1800	
	2.10.2 Methods for managing recreation		3400	
2.11	UTILIZATION OF URBAN FORESTS AND WASTEWOOD	3		2,3
	Lead Program			
	2.11.1 Measure supply		1100	
	2.11.2 Decrease utilization costs		2000	

TOTAL TARGET 2---------- $69,600,000

TARGET 3 - DEVELOP METHODS TO BREED, SELECT, ESTABLISH, MAINTAIN, AND PROTECT URBAN FOREST RESOURCES FOR USE AT DIFFERENT LOCATIONS WITHIN THE URBAN COMPLEX

		Priority[1]	Cost $M[2]	Regional Emphasis[3]
3.1	SOIL, WATER, SITE REQUIREMENTS	1		8
	Lead Program			
	3.1.1 Identify and improve environmental components		3400	
	3.1.2 Soil-plant-atmospheric conditions		3000	
	3.1.3 Develop mycorrhizae		2700	
3.2	SELECT AND DEVELOP URBAN FOREST VEGETATION	1		1,2,4,5
	Lead Program			
	3.2.1 Criteria for selecting vegetation		1600	
	3.2.2 Develop improved regional varieties		6000	
	3.2.3 Test varieties under urban stress		2000	
	Optimizing Program			
	3.2.4 Determine useful genetic variation		2000	
	3.2.5 Breeding strategy comparisons		1000	
	Safeguard Program			
	3.2.6 Improved varieties from other countries		1000	

	Priority[1]	Cost $M[2]	Regional Emphasis[3]
3.3 ESTABLISH AND MANAGE URBAN FOREST VEGETATION CAPABLE OF GROWING AT SPECIFIC LOCATIONS THROUGHOUT THE URBAN COMPLEX	2		8
Lead Program			
3.3.1 Establishment of urban forests		1200	
3.3.2 Management systems		2700	
Optimizing Program			
3.3.3 Natural reproduction from urban forests		800	
3.4 DEVELOP CONTROL SYSTEMS FOR MAJOR INSECT AND DISEASE PROBLEMS IN URBAN FOREST MANAGEMENT PROBLEMS	1		8
Lead Program			
3.4.1 Determine control opportunities		3200	
3.4.2 Control impacts of major disease		3000	
3.4.3 Protect urban forests from stress		3400	
3.4.4 Cultural and chemical control of insects		3100	
3.4.5 Biological control of insects		2700	

		Priority[1]	Cost $M[2]	Regional Emphasis[3]
	Optimizing Program			
	3.4.6 Pest management models		2600	
	3.4.7 Stress-induced host vigor		800	
	3.4.8 Environmental and climate influence on insects and disease		3100	
	Supplementary Program			
	3.4.9 Environmental pollutants influence on insects and disease		1100	
3.5	DEVELOP METHODS TO PROTECT URBAN FORESTS FROM DETERMINED IMPACTS OF FIRE, ANIMALS, AND MAN'S ACTIVITIES	2		2,5
	Lead Program			
	3.5.1 Define extent of wildfire problem and prevention needs		800	
	3.5.2 Methods for fuel modification		600	
	3.5.3 Fire control methods and programs		1000	
	3.5.4 Protection from man's activities and animals		1200	

	Priority[1/]	Cost $M[2/]	Regional Emphasis[3/]
3.6 DEVELOP AN ASSESSMENT AND INVENTORY SYSTEM TO MONITOR INFORMATION NECESSARY TO CARRY OUT LONG TERM URBAN FOREST MANAGEMENT PROGRAMS	1		7
Lead Program			
3.6.1 Develop, test, and establish system		1400	
TOTAL TARGET 3----------		$55,400,000	

TARGET 4 - DEVELOP STRATEGIES TO INTEGRATE SOUND URBAN FORESTRY PLANNING AND MANAGEMENT INTO THE URBAN PLANNING AND DEVELOPMENT PROCESS

		Priority[1]	Cost $M[2]	Regional Emphasis[3]
4.1	INFLUENCE OF URBAN DEVELOPMENT ON URBAN FOREST PATTERNS	2		1,2,5,6
	Lead Program			
	4.1.1 Socioeconomic effects on urban forest benefits		1200	
	4.1.2 Public infrastructure effects on urban forests		1600	
	4.1.3 Urban services effects on urban forests		1200	
4.2	DEVELOP AND TEST LAND USE CONTROL SYSTEMS	1		1,2,5,6
	Lead Program			
	4.2.1 Design new land use control systems and policies		2400	
4.3	DEVELOP ADMINISTRATIVE SYSTEMS	2		7
	Lead Program			
	4.3.1 Develop administrative programs		1800	
4.4	DETERMINE INFLUENCE OF CHANGING TECHNOLOGY AND SOCIAL CLIMATE	2		7
	Lead Program			
	4.4.1 Monitor technological and social change		1000	

		Priority[1]	Cost $M[2]	Regional Emphasis[3]
4.5	INFORMATION EXCHANGE AND PUBLIC INVOLVEMENT	1		7
	Lead Program			
	4.5.1 Develop information and education programs		1200	
	4.5.2 Stimulate involvement		2000	
	4.5.3 Design and conduct education programs		1200	
4.6	PILOT TESTS	2		8
	Lead Program			
	4.6.1 Short term pilot tests		1600	
	4.6.2 Long term tests		900	

TOTAL TARGET 4---------- $16,100,000

APPENDIX IV

ALTERNATIVE R&D PROGRAMS FOR THREE LEVELS OF FUNDING: 3, 6, AND 9 MILLION/YEAR FOR 10 YEARS

Alternative R&D Programs for Three Levels of Funding

Total Dollars (M) Available for 10 Years	Program Emphasis																Total Cost
	Target 1			Target 2			Target 3			Target 4							
	Program	Description	Cost	Program	Description	Cost	Program	Description	Cost	Program	Description	Cost					
	1.1.1	Social values	0.8	2.4.3	Energy conservation	1.3	3.1.1	Site improvement	3.4								
				2.5.2	Water yield	2.0	3.2.1	Tree selection criteria	1.6								
30				2.5.4	Watershed multiple use	2.8	3.2.2	Improved varieties	6.0								
				2.10.2	Recreation management	3.4											
Involves only selected lead programs in priority 1 categories							3.4.1	Insect and disease control opportunities	3.2								
							3.4.3	Protection	3.4								
							3.4.4	Insect control	3.1								
Cost Subtotals			0.8			9.5			20.7								31.0 [1]
	All of the above plus.....																
	1.4.1	Aesthetic and recreation benefits	2.0	2.4.1	Laboratory windbreak tests	0.6	3.1.2	Soil/plant	3.0	4.2.1	Land use	2.4					
				2.4.2	Field windbreak tests	1.4	3.1.3	Mycorrhizae	2.7	4.5.1	Information and education	1.2					
60				2.5.1	Water supply	1.2	3.2.3	Urban stress	2.0								
Involves most lead programs in priority 1 categories				2.5.3	Water quality	2.8	3.4.2	Diseases	3.0	4.5.2	Stimulate involvement	2.0					
				2.10.1	Recreation supply	1.8	3.4.5	Biological control	2.7								
							3.6.1	Inventory system	1.4								
Cost Subtotals			2.8			17.3			35.5			5.6					61.2 [1]
	All of the above plus.....			2.1.3	Acid precipitation	3.2				4.1.-	Urban development	4.0					
	1.2.1	Human response	1.4														
	1.2.2	Benefits	1.6	2.3.1	Trees/microclimate	0.8				4.3.1	Administrative systems	1.8					
90	1.2.3	Public concerns	1.4	2.6.1	Recycling wastewater	4.2	3.3.1	Establishment	1.2								
				2.6.3	New application methods	1.6	3.3.2	Management systems	2.7	4.4.1	Technology assessment	1.0					
Involves all lead programs in priority 1 categories, and selected lead programs in priority 2 categories	1.3.1	Physical health benefits	0.8				3.5.-	Fire	3.6								
	1.3.2	Air pollution	0.8	2.7.2	Urban wildlife	1.0				4.5.3	Conduct education	1.2					
	1.5.1	Energy savings	1.2														
										4.6.-	Pilot tests	2.5					
Cost Subtotals			10.0			28.1			43.0			10.5					91.7 [1]

[1] If necessary, reduce or increase program costs slightly to match funding.

APPENDIX V

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